Alberta Environment

Design and Construction Division

Willow Creek Project
Pine Coulee Reservoir
Geotechnical Design - Executive Summary

October 1985

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Due to increased water demands and continued drought conditions in the southern part of the province, additional water storage within the Willow Creek basin appears to be imminent. As a result, a preliminary design and feasibility assessment together with a cost estimate for an offstream storage reservoir within Pine Coulee along with the associated diversion works from Willow Creek was requested by Alberta Environment Planning Division.

The major components associated with the development of this storage reservoir include the construction of an earth dam across the downstream end of Pine Coulee, a saddle dyke along the southeast periphery of the proposed reservoir, a major causeway at the Highway #527 coulee crossing and a minor causeway crossing near the northern boundary of the reservoir. In addition, the major components associated with the diversion works from Willow Creek include the construction of a diversion weir on Willow Creek, a diversion headgate structure, a diversion channel and the Pine Coulee reservoir inlet structure.

The proposed Pine Coulee dam would be approximately 21 m in height and 450 m in length along its crest. It would be located within the SW 34-13-28-W4, approximately 400 m upstream of the confluence of Pine Coulee and Willow Creek. The resulting reservoir would be approximately 12 km in length and would cover some 6.0 km^2 in area. The storage capacity of the reservoir would be approximately 50.3 million m^3 at the design FSL elevation of 1052.5 and a minimum ponding elevation of 1044 was assumed for design purposes.

A preliminary foundation investigation indicated that along the dam centerline, approximately 14 m of alluvial clay overlies shale and sandstone bedrock. Within this 14 m of alluvium at a depth which varies between 4 to 6 m, a soft clay layer exists ranging in thickness from 1 to 4 m. The presence of this soft clay layer has resulted in the recommended upstream and downstream slopes of the dam embankment being relatively flat with berms being required adjacent to both slopes. The presence of this soft layer will also necessitate that the dam be constructed in two stages with each stage being constructed in a single construction season. To assist in coping with the soft layer, wick drains will be required beneath both the upstream and downstream slopes of the dam.

The reservoir created by the construction of the dam will flood four local roads which presently cross the coulee. For cost estimating purposes, it was assumed that the most southerly road would be re-routed

across the dam, that a major causeway would be constructed for the Highway #527 crossing, that a minor raising of the existing roadway would be adequate for the most northerly crossing and that the fourth crossing would be abandoned completely. The construction of the Highway #527 crossing is a relatively expensive component of this project since the total height of embankment required is approximately 16 m. Furthermore, since this crossing is underlain by a similar soft clay layer as is present at the dam site, relatively flat embankment slopes, berms and the wick drains will again be required. This crossing will also require a substantial quantity of riprap slope protection since both of the embankment slopes will be susceptible to wave attack.

A substantial quantity of riprap slope protection will also be required for the saddle dyke along the southeast periphery of the proposed reservoir. The length of this dyke is approximately 2940 m and the height of the dyke varies from a maximum of 12 m to a minimum of 4 m.

The geotechnical considerations for the remaining components of this project are relatively standard and no unusually complex or expensive features will be required.

A detailed cost estimate has been prepared for the project and a summary itemizing the costs of each of the major components has been attached. The total cost of the overall project has been estimated to be

$29.5 million. This estimate includes a 15% allowance for contingencies but does not include any provision for engineering costs.

For the final project design, detailed site investigations and comprehensive laboratory testing will be required for each of the major components. In addition, an extensive impervious borrow material search will be required to identify the most suitable clay till material within the area. Investigations to date have indicated that most of the till in the area is of low plasticity with a relatively high silt content. A large quantity of riprap material will also be required and consequently, a substantial source of riprap material will have to be identified and investigated to confirm that the required quantity is available.

WILLOW CREEK PROJECT

PINE COULEE RESERVOIR

SITE 2

COST SUMMARY

A)	Site Services	$ 980,000
B)	Diversion Weir	$ 3,450,000
C)	Headgates	$ 250,000
D)	Diversion Channel	$ 2,182,000
E)	Reservoir Inlet	$ 327,000
F)	Dam Embankment	$ 8,922,000
G)	Outlet Works	$ 1,420,000
H)	Saddle Dyke	$ 4,410,000
I)	Causeway @ Highway #527	$ 3,580,000
J)	Causeway @ E-W Road (N.Bdy. of 33-14-28-w4)	$ 572,000
K)	Road Relocation	$ 700,000
L)	Reservoir	$ 2,700,000
	Total	$ 29,493,000
	Say	$ 29,500,000

COST ITEM

A) Site Services

1)	Performance Bond	L.S.	$ 80,000
2)	Labour & Materials Bond	L.S.	$ 40,000
3)	Construction Camp & Office	L.S.	$ 200,000
4)	Construction Roads	5 km @ $25,000	$ 125,000
5)	Powerlines	10 km @ $20,000	$ 200,000
6)	Utilities	L.S.	$ 50,000
7)	Surface Drainage	L.S.	$ 50,000
8)	Landscaping	L.S.	$ 50,000
9)	Miscellaneous		$ 50,000
			$ 845,000
		x 1.15	$ 971,750
		Say	$ 980,000

B) Diversion Weir

1)	Mobilization & Demobilization	L.S.	$ 100,000
2)	Care of Water	L.S.	$ 150,000
3)	Common Excavation	228,000 m^3 @ $1.6	$ 364,800
4)	Structural Excavation	1,000 m^3 @ $3.0	$ 3,000
5)	Compacted Impervious Fill	53,000 m^3 @ $1.00	$ 53,000
6)	Tamped Impervious Backfill	1,000 m^3 @ $5.00	$ 5,000
7)	Riprap	6,700 m^3 @ $50.00	$ 335,000
8)	Coarse Filter	2,300 m^3 @ $15.00	$ 34,500
9)	Fine Filter	1,100 m^3 @ $18.00	$ 19,800
10)	Drain Gravel	4,400 m^3 @ $20.00	$ 88,000
11)	Topsoil & Seeding	4.7 Ha @ $7000.0	$ 32,900
12)	Sheet Piling	500 m^2 @ 200.0	$ 100,000
13)	Lean Concrete	140 m^3 @ 200.0	$ 28,000
14)	Reinforced Concrete	4,100 m^3 @ $350.0	$1,435,000
15)	Gate & Hoist, 5000 x 4000 mm Radial Gate	1 Unit @ $100,000	$ 100,000
16)	Fish Pass	L.S.	$ 50,000
17)	Miscellaneous		$ 100,000
			$2,999,000
		x 1.15	$3,448,850
		Say	$3,450,000

C) **Headgates**

1)	Structural Excavation	300 m^3 @ $3.0	$ 900
2)	Compacted Impervious Fill	3900 m^3 @ $1.00	$ 3,900
3)	Tamped Impervious Backfill	1300 m^3 @ $5.00	$ 6,500
4)	Riprap	700 m^3 @ 50.0	$ 35,000
5)	Coarse Filter	400 m^3 @ $15.00	$ 6,000
6)	Fine Filter	200 m^3 @ $18.00	$ 3,600
7)	Drain Gravel	200 m^3 @ $20.00	$ 4,000
8)	Road Gravel	10 m^3 @ $10.0	$ 100
9)	Lean Concrete	10 m^3 @ $200.0	$ 2,000
10)	Reinforced Concrete	250 m^3 @ $400.0	$100,000
11)	Gates & Hoists, 72" x 96" Sluice Gate	3 Units @ $10,000	$ 30,000
12)	Miscellaneous		$ 25,000
			$217,000
		x 1.15	$249,550
		Say	$250,000

D) Diversion Channel

1)	Common Excavation	790,500 m^3 @ $1.60	$1,264,800
2)	Compacted Impervious Fill	82,000 m^3 @ 1.00	$ 82,000
3)	Gravel Liner	16,000 m^3 @ $10.00	$ 160,000
4)	Road Gravel	1,600 m^3 @ $10.00	$ 16,000
5)	Topsoil & Seeding	3.50 Ha @ $7,000	$ 24,500
6)	Cross Drainage	2 Units @ $50,000	$ 100,000
7)	Bridge	200 m^2 @ $1,000	$ 200,000
8)	Fencing		$ 20,000
9)	Miscellaneous		$ 30,000
			$1,897,300
		x 1.15	$2,181,895
		Say	$2,182,000

E) Reservoir Inlet

1)	Structural Excavation	7,200 m^3 @ $3.0	$ 21,600
2)	Tamped Impervious Fill	2,100 m^3 @ $5.0	$ 10,500
3)	Riprap	100 m^3 @ $50.0	$ 10,000
4)	Coarse Filter	860 m^3 @ $15.00	$ 12,900
5)	Fine Filter	620 m^3 @ $18.00	$ 11,160
6)	Lean Concrete	65 m^3 @ $200	$ 13,000
7)	Reinforced Concrete	450 m^3 @ $400	$180,000
8)	Miscellaneous		$ 25,000
			$284,160
		x 1.15	$326,784
		Say	$327,000

F) Dam Embankment

1)	Mobilization & Demobilization	L.S.	$ 400,000
2)	Care of Water	L.S.	$ 50,000
3)	Common Excavation	1,248,300 m^3 @ $1.60	$1,997,280
4)	Compacted Impervious Fill	1,021,100 m^3 @ $1.00	$1,021,100
5)	Coarse Filter	94,200 m^3 @ $15.00	$1,413,000
6)	Fine Filter	90,800 m^3 @ $18.00	$1,634,400
7)	Pitrun Gravel	13,400 m^3 @ $8.00	$ 107,200
8)	Riprap	13,350 m^3 @ $50.00	$ 667,500
9)	Road Gravel	550 m^3 @ $10.00	$ 5,500
10)	Topsoil & Seeding	6.4 Ha @ $7000.00	$ 44,480
11)	Wick Drain	L.S.	$ 232,000
12)	Instrumentation	L.S.	$ 35,000
13)	Road Guardrail	L.S.	$ 50,000
14)	Miscellaneous		$ 100,000
			$7,757,780
		x 1.15	$8,921,447
		Say	$8,922,000

G) Outlet Works

1)	Common Excavation	78,100 m^3 @ $1.6	$ 124,960
2)	Structural Excavation	10,800 m^3 @ $3.0	$ 32,400
3)	Tamped Impervious Backfill	7,800 m^3 @ $5.00	$ 39,000
4)	Riprap	200 m^3 @ $50.00	$ 10,000
5)	Coarse Filter	200 m^3 @ $15.00	$ 3,000
6)	Fine Filter	150 m^3 @ $18.00	$ 2,700
7)	Lean Concrete	45 m^3 @ $200.0	$ 9,000
8)	Reinforced Concrete	2,000 m^3 @ $350	$ 700,000
9)	Bituminous Paint	L.S.	$ 30,000
10)	Gate & Lift - 60" x 84" Sluice Gate	1 Unit @ $50,000	$ 50,000
11)	Air Vent	L.S.	$ 20,000
12)	Safety Ladder	L.S.	$ 60,000
13)	Metal Building	L.S.	$ 100,000
14)	Miscellaneous		$ 50,000
			$1,231,060
		x 1.15	$1,415,719
		Say	$1,420,000

H) Saddle Dyke

1)	Common Excavation	651,000 m^3 @ $1.60	$1,041,600
2)	Compacted Impervious Fill	473,000 m^3 @ $1.00	$ 473,000
3)	Riprap	29,000 m^3 @ $50.00	$1,450,000
4)	Pitrun Gravel	37,000 m^3 @ $8.00	$ 296,000
5)	Coarse Filter	19,000 m^3 @ $15.00	$ 285,000
6)	Fine Filter	9,000 m^3 @ $18.00	$ 162,000
7)	Road Gravel	3,400 m^3 @ $10.0	$ 34,000
8)	Topsoil & Seeding	3.5 Ha @ $7,000	$ 24,500
9)	Road Guardrail	L.S.	$ 15,000
10)	Miscellaneous		$ 50,000
			$3,831,100
		x 1.15	$4,405,765
		Say	$4,410,000

I) Causeway @ Highway # 527

1)	Mobilization & Demobilization	L.S.	$ 100,000
2)	Traffic Detour & Control	L.S.	$ 50,000
3)	Common Excavation	334,000 m^3 @ $1.60	$ 534,400
4)	Compacted Impervious Fill	261,000 m^3 @ $1.00	$ 261,000
5)	Road Subbase & Pavement	L.S.	$ 42,000
6)	Riprap	19,000 m^3 @ $50.00	$ 950,000
7)	Coarse Filter	29,000 m^3 @ $15.00	$ 435,000
8)	Fine Filter	23,500 m^3 @ $18.00	$ 423,000
9)	Pitrun Gravel	10,600 m^3 @ $8.00	$ 84,800
10)	Wick Drain	L.S.	$ 100,000
11)	SPCSP Extended & Up-graded	L.S.	$ 50,000
12)	Road Guardrail	L.S.	$ 30,000
13)	Miscellaneous		$ 50,000
			$3,110,200
		x 1.15	$3,576,730
		Say	$3,580,000

J) Causeway @ EW Road - North Boundary of 33-14-28-W4

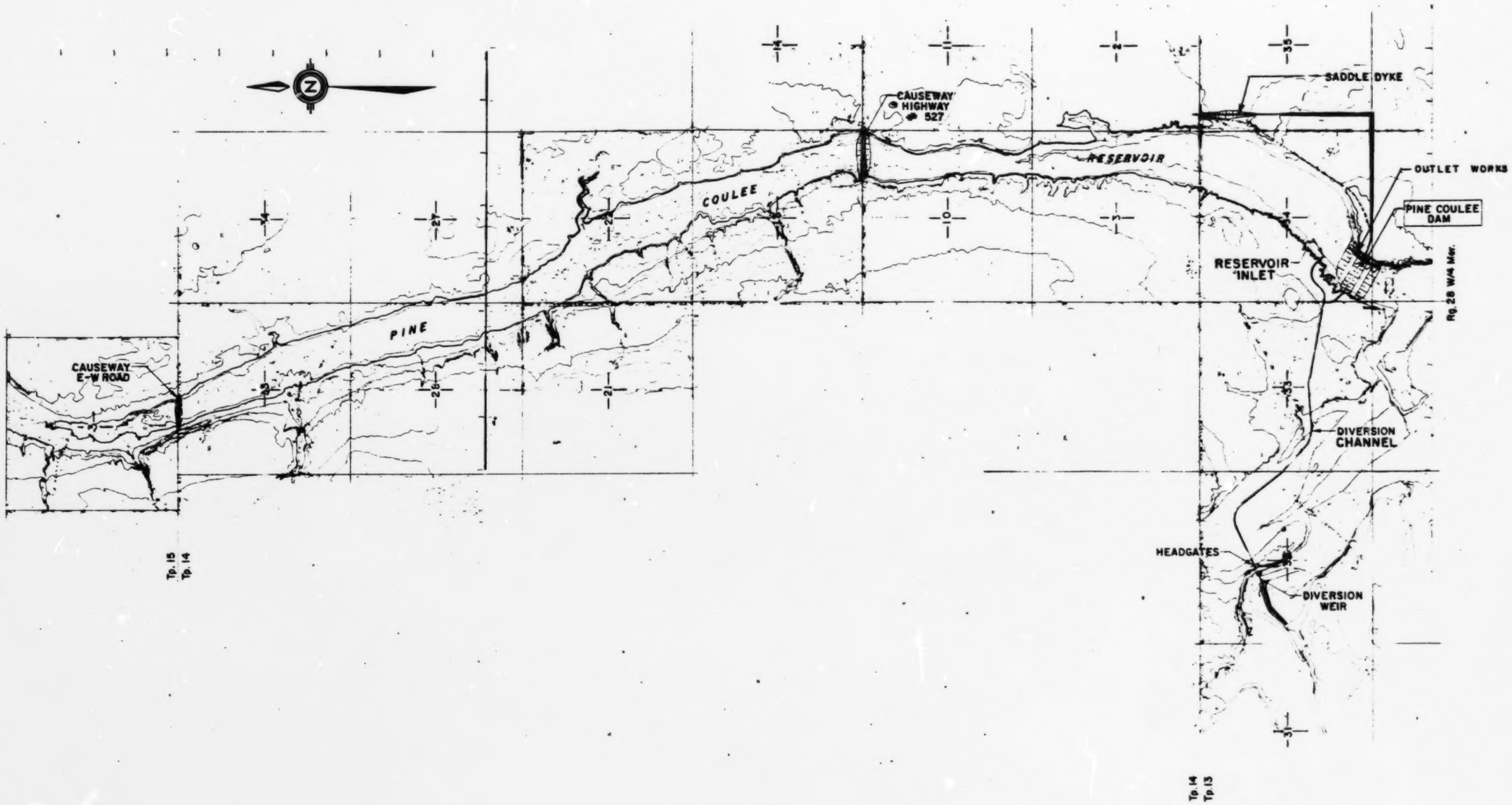
1)	Traffic Detour & Control	L.S.	$ 20,000
2)	Common Excavation	37,500 m^3 @ $1.60	$ 60,000
3)	Compacted Impervious Fill	27,500 m^3 @ $1.00	$ 27,500
4)	Riprap	3,730 m^3 @ $50.0	$ 186,500
5)	Coarse Filter	2,850 m^3 @ $15.00	$ 42,750
6)	Fine Filter	1,700 m^3 @ $18.00	$ 30,600
7)	Road Sub-base & Pavement	L.S.	$ 30,000
8)	Gated CSP Structure	L.S.	$ 60,000
9)	Road Guardrail	L.S.	$ 20,000
10)	Miscellaneous		$ 20,000
			$ 497,350
		x 1.15	$ 571,953
		Say	$ 572,000

K) Road Relocation

1)	Traffic Detour & Control	L.S.	$ 50,000
2)	Upgraded Gravel Road	3.3. km @ $40,000	$ 132,000
3)	New Gravel Road	4.8 km @ $60,000	$ 288,000
4)	Fencing	9,600 m @ $3.0	$ 28,000
5)	Traffic Sign	L.S.	$ 10,000
6)	Miscellaneous		$ 50,000
			$ 558,800
		x 1.15	$ 642,620
		Say	$ 700,000

List of Drawings

1. Key Plan
2. General Plan
3. Site Plan
4. Diversion Weir General Arrangement
5. Diversion Weir
6. Headgates
7. Diversion Channel Profile, Sta. 0+000 to Sta. 1+800
8. Diversion Channel Profile, Sta. 1+800 to Sta. 3+550
9. Reservoir Inlet Plan and Profile
10. Dam Embankment General Plan
11. Typical Dam Embankment Cross Section
12. Outlet Works
13. Saddle Dyke
14. Causeway @ Highway #527
15. Causeway E-W Road, N. Bdy. of 33-14-28-W4



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Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

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WILLOW CREEK PROJECT
PINE COULEE RESERVOIR

GENERAL PLAN

SCALE 1:20000	SHEET 2 OF 15
DATE AUGUST, 1985	DWG. No. PICOR - EES-06

CENTRAL FILE No.
DRAWING FILE No. PICOR 0003
MICROFILM DATE

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HEADGATES
DIVERSION WEIR
DIVERSION CHANNEL

SADDLE DYKE

DIVERSION CHANNEL

RESERVOIR INLET

PINE COULEE DAM

OUTLET WORKS

N

Alberta ENVIRONMENT WATER RESOURCES DESIGN AND CONSTRUCTION DIVISION

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PINE COULEE RESERVOIR

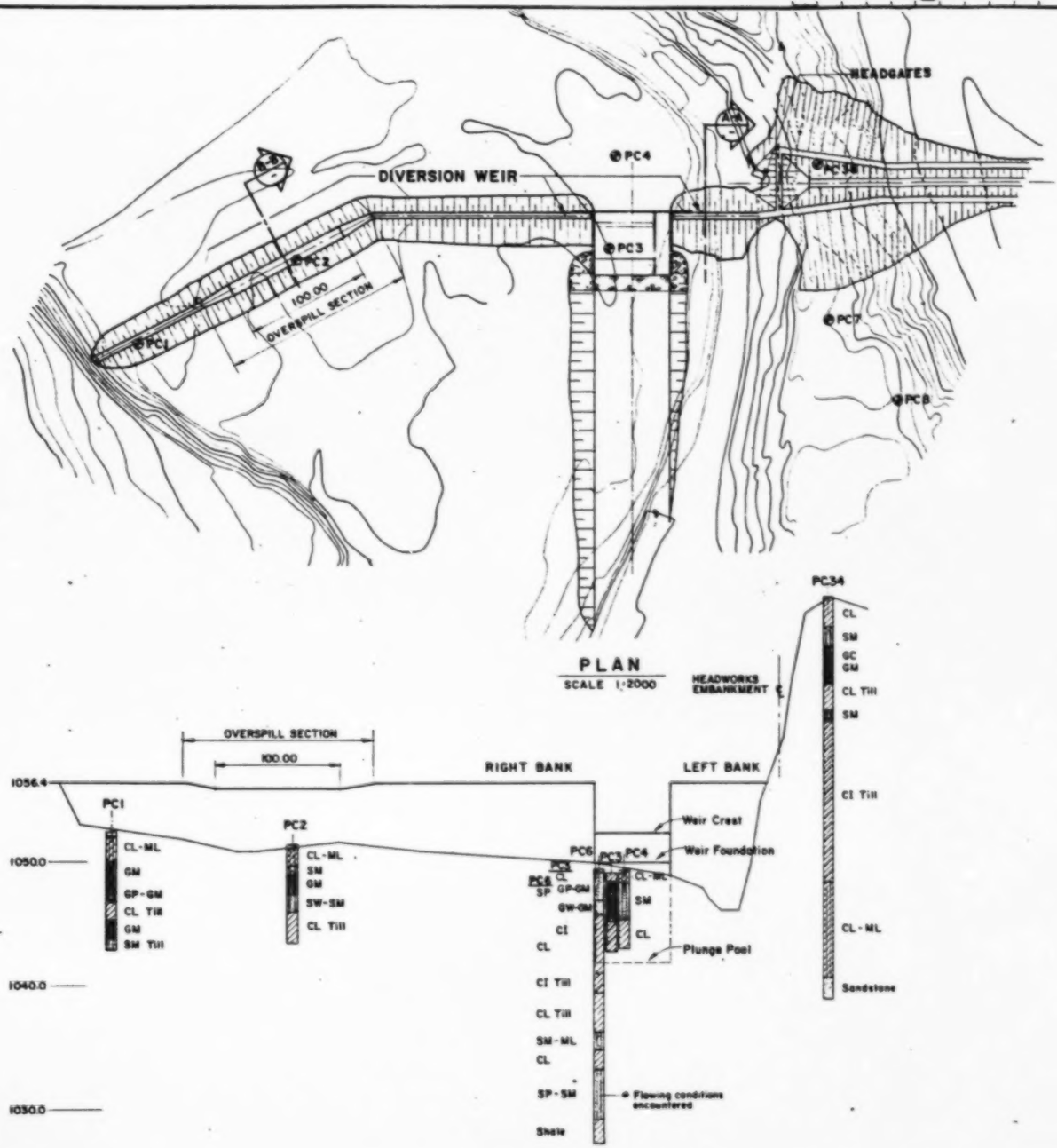
SITE PLAN

SCALE 1:5000

DATE AUGUST, 1985

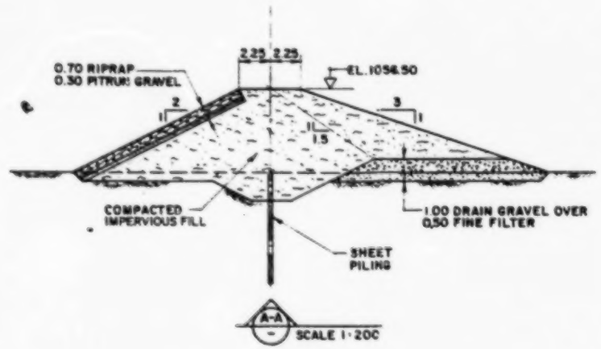
SHEET 1 OF 18 SHEETS

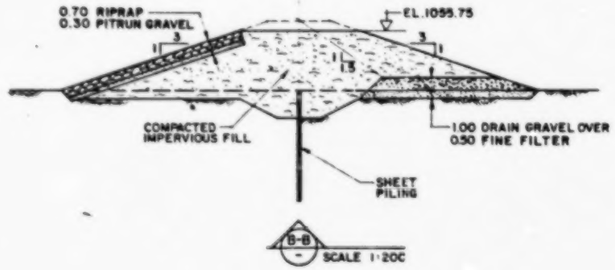
DRAWING NO. 85-08-18-E-01



PLAN
SCALE 1:2000

STRATIGRAPHIC SECTION
LOOKING UPSTREAM
SCALE - Vert. 1:200, Horiz. 1:2000





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Alberta Environment — Design and Construction Division

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APPROVED ..... DRAWN .....
DATE ..... CHECKED .....

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR
DIVERSION WEIR
GENERAL ARRANGEMENT

SCALE AS SHOWN | SHEET 4 OF 15
DATE SEPTEMBER, 1985 | DWG. No.

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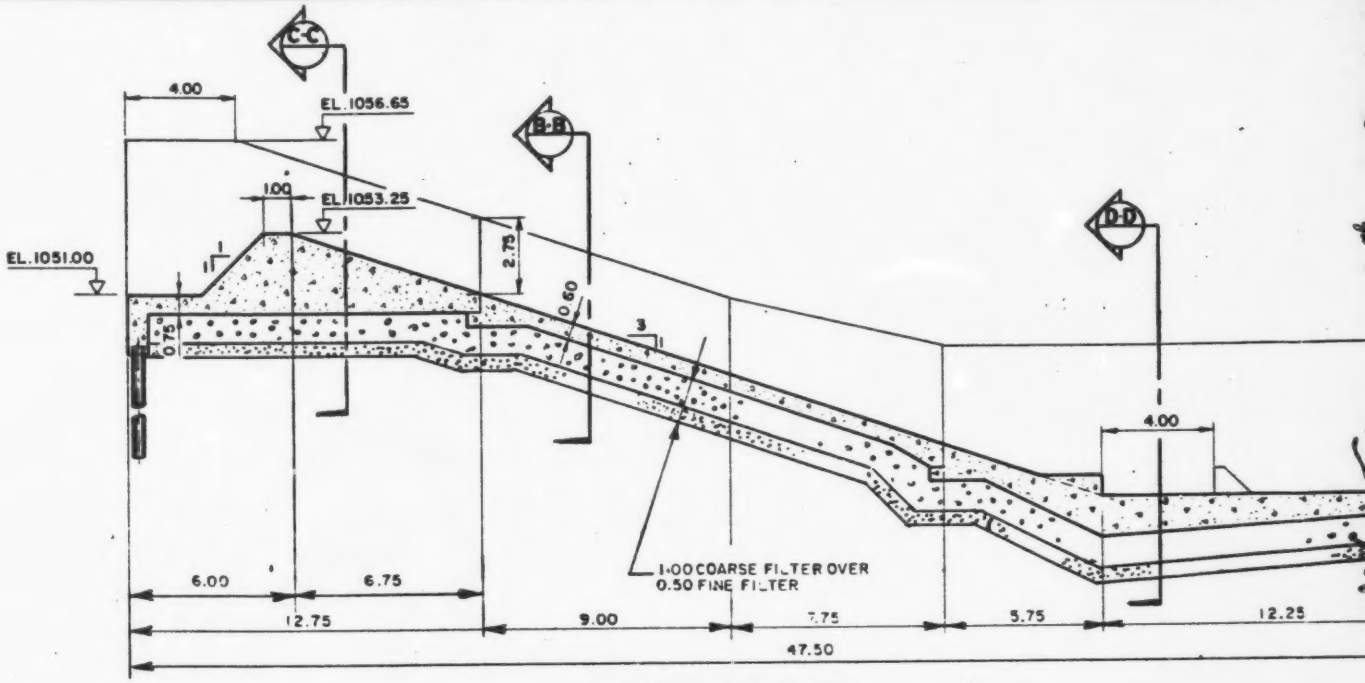
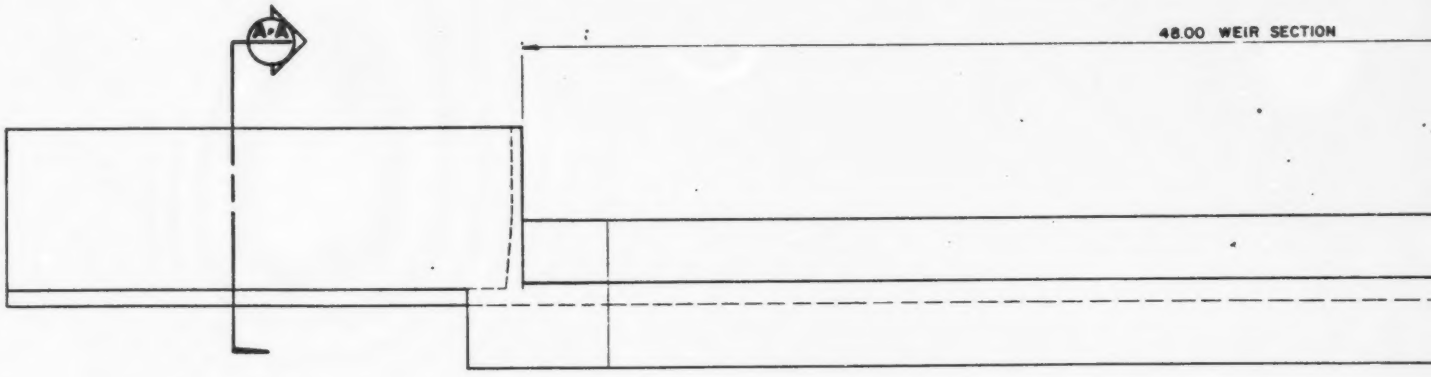
CENTRAL FILE No.

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR
KEY PLAN



℄ WEIR SECTION



FRONT ELEVATION

MICROFILM DATE

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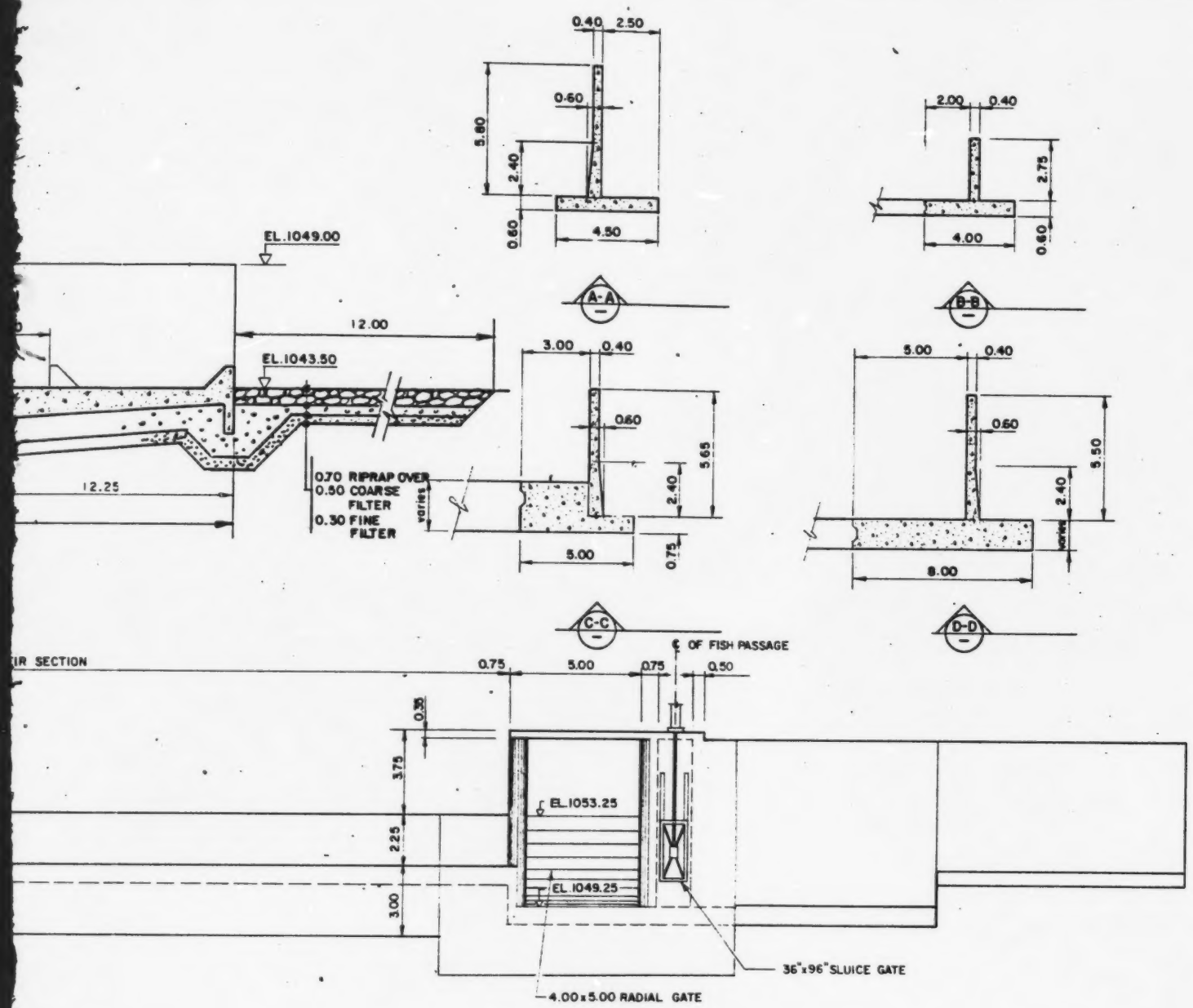

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Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

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WILLOW CREEK PROJECT
PINE COULEE RESERVOIR

DIVERSION WEIR

SCALE 1:125	SHEET 5 OF 15
DATE AUGUST, 1985	DWG. No PICOR-E85-14

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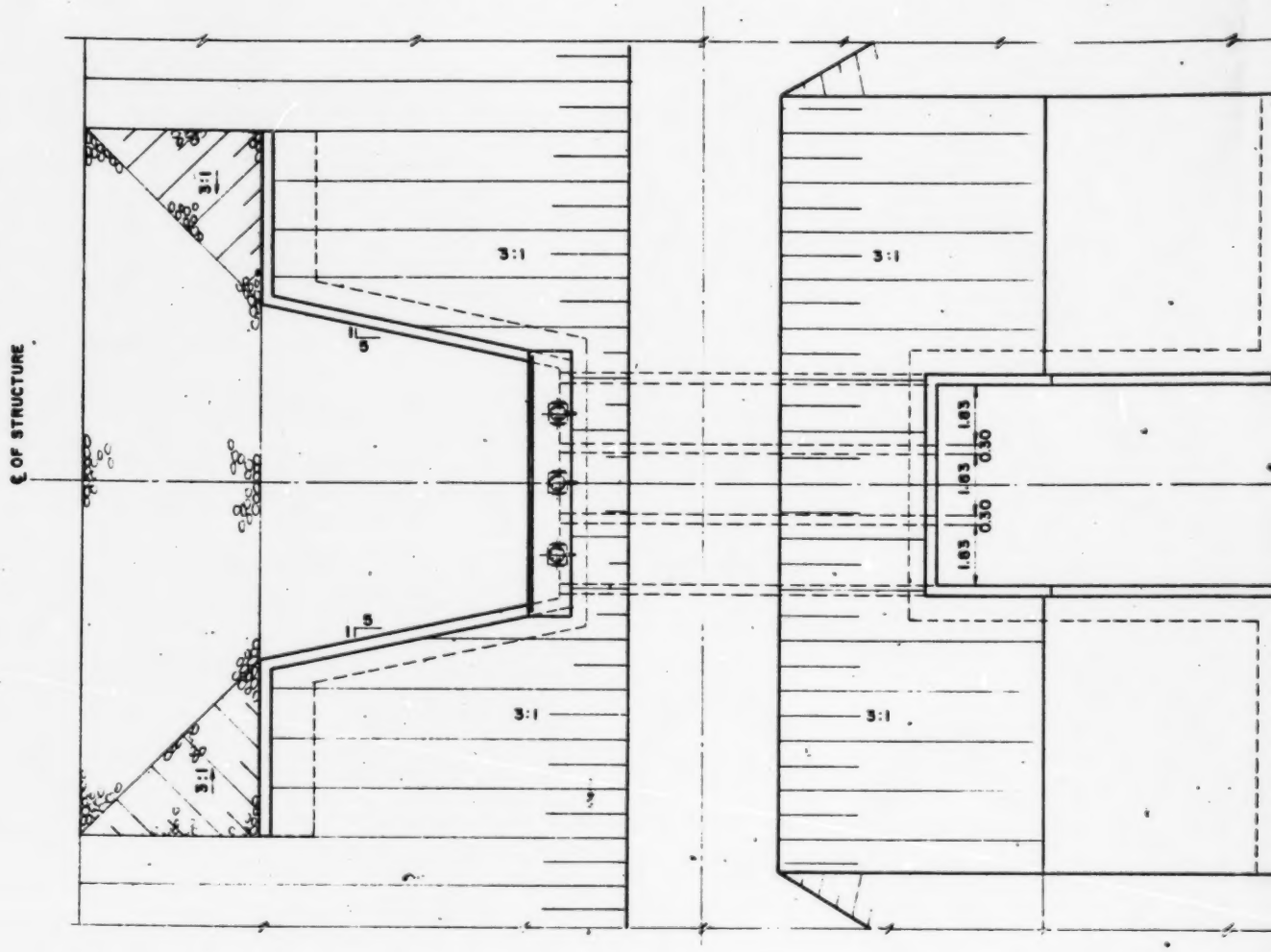
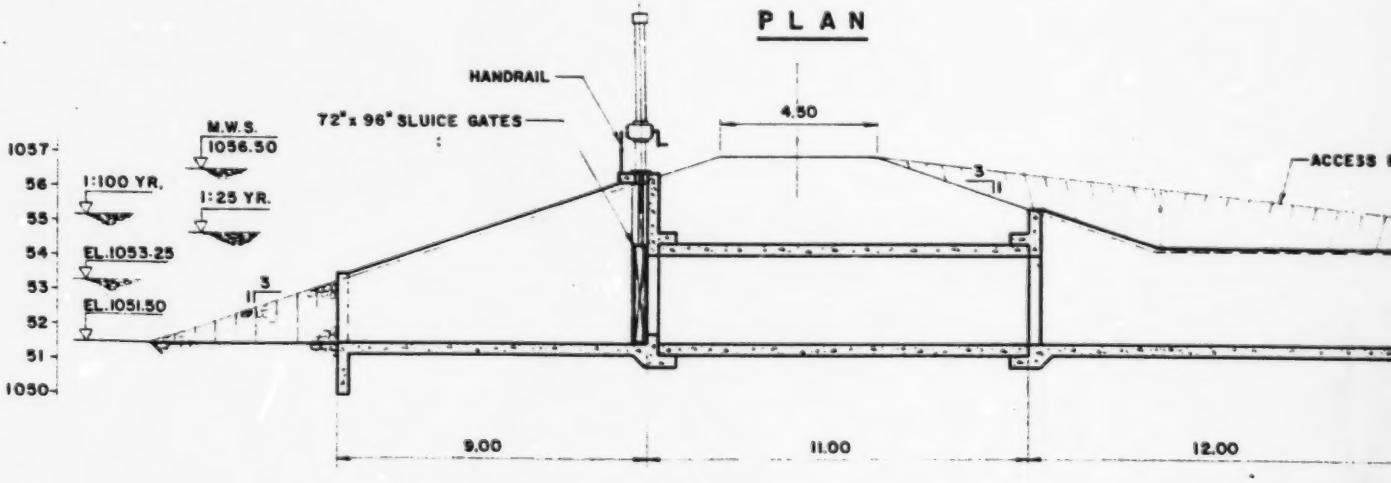


PLAN



CENTRE LINE SECTION

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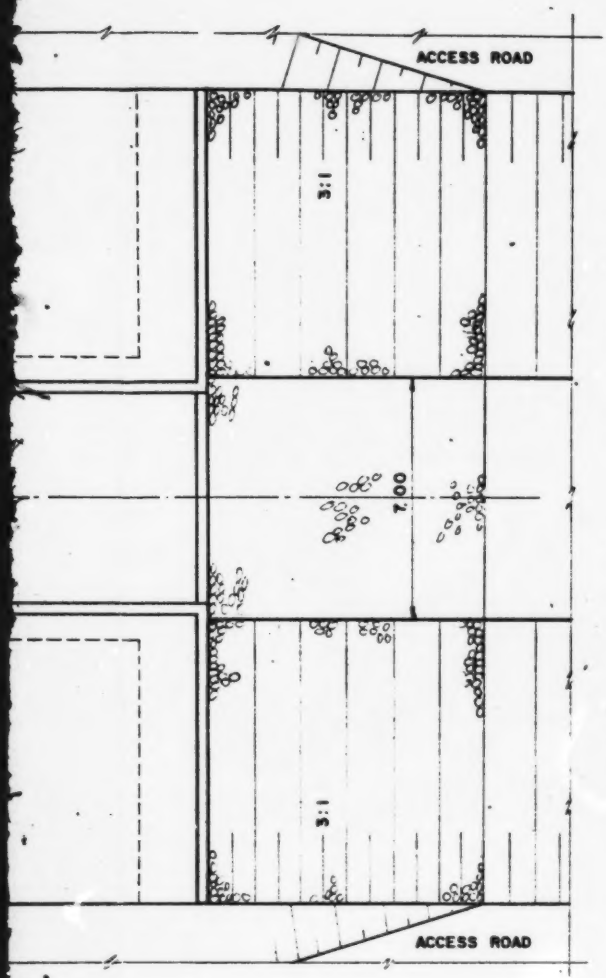
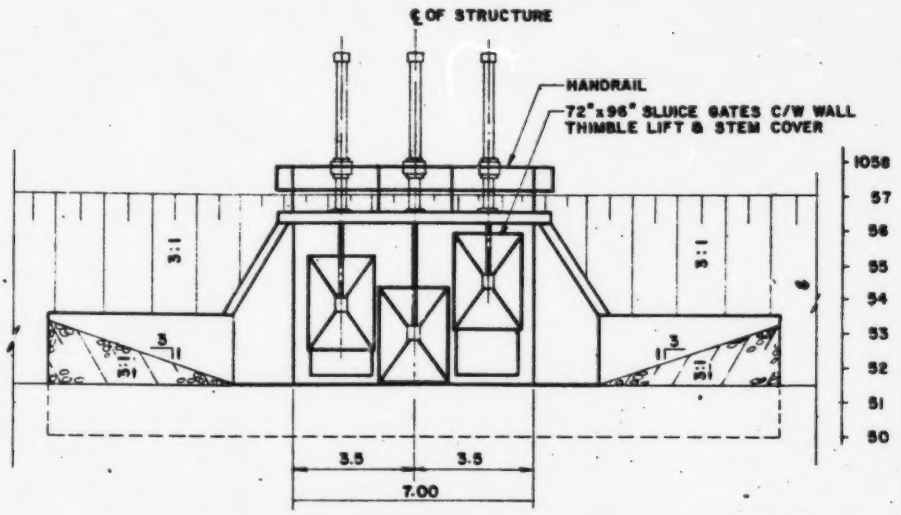
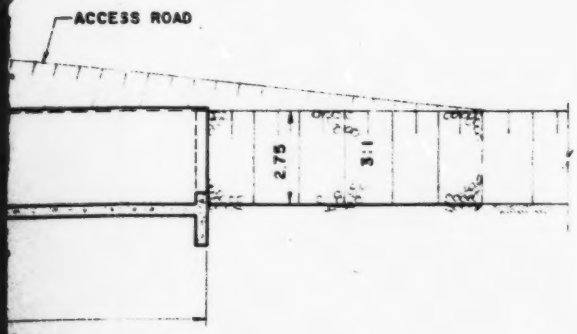




UPSTREAM ELEVATION



NATURE OF REVISION	DATE	ENG.	DWN.

Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

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WILLOW CREEK PROJECT
PINE COULEE RESERVOIR

HEAD GATES

SCALE 1:100	SHEET 6 OF 15
DATE AUGUST, 1985	DWG. No. PICOR - E85-15

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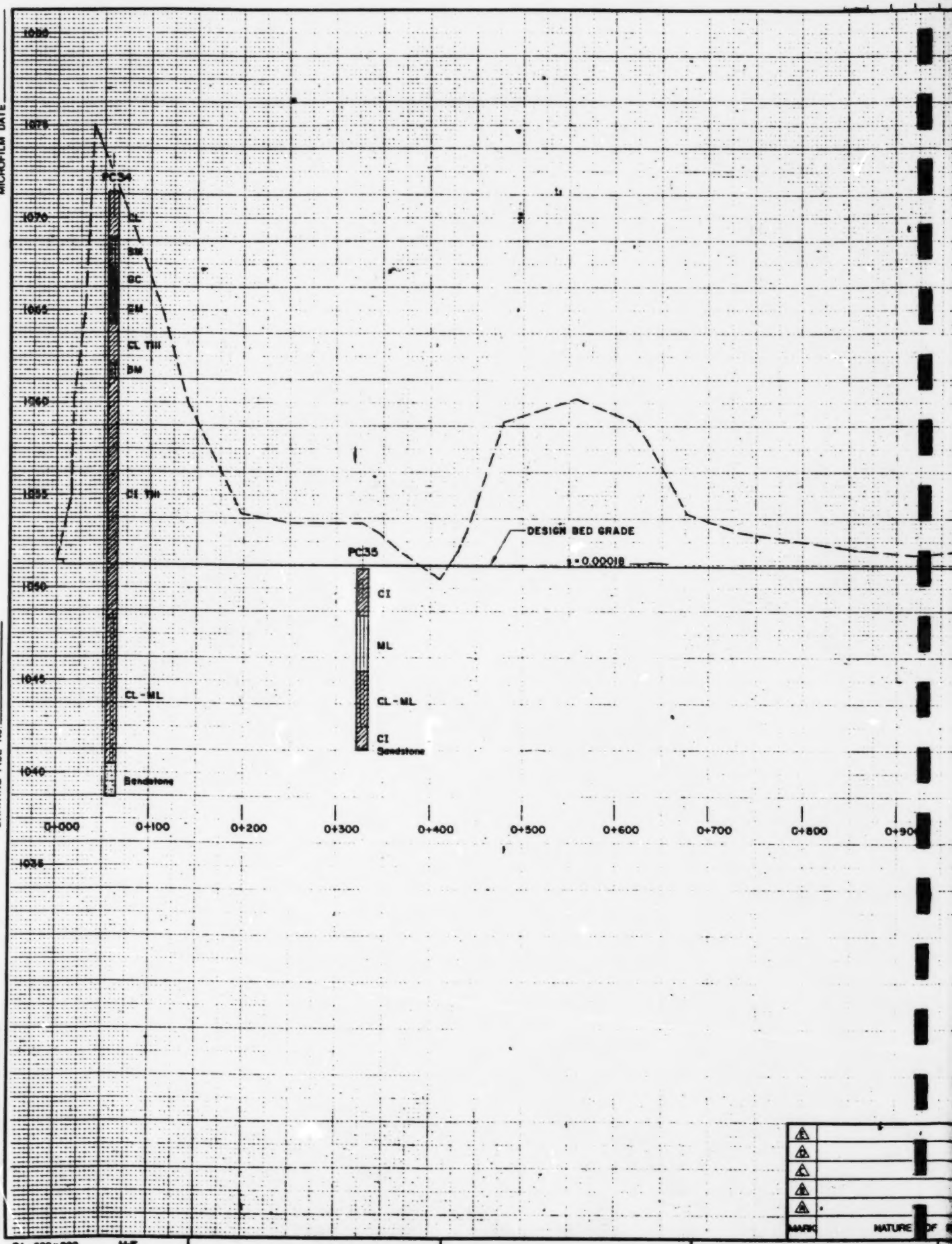
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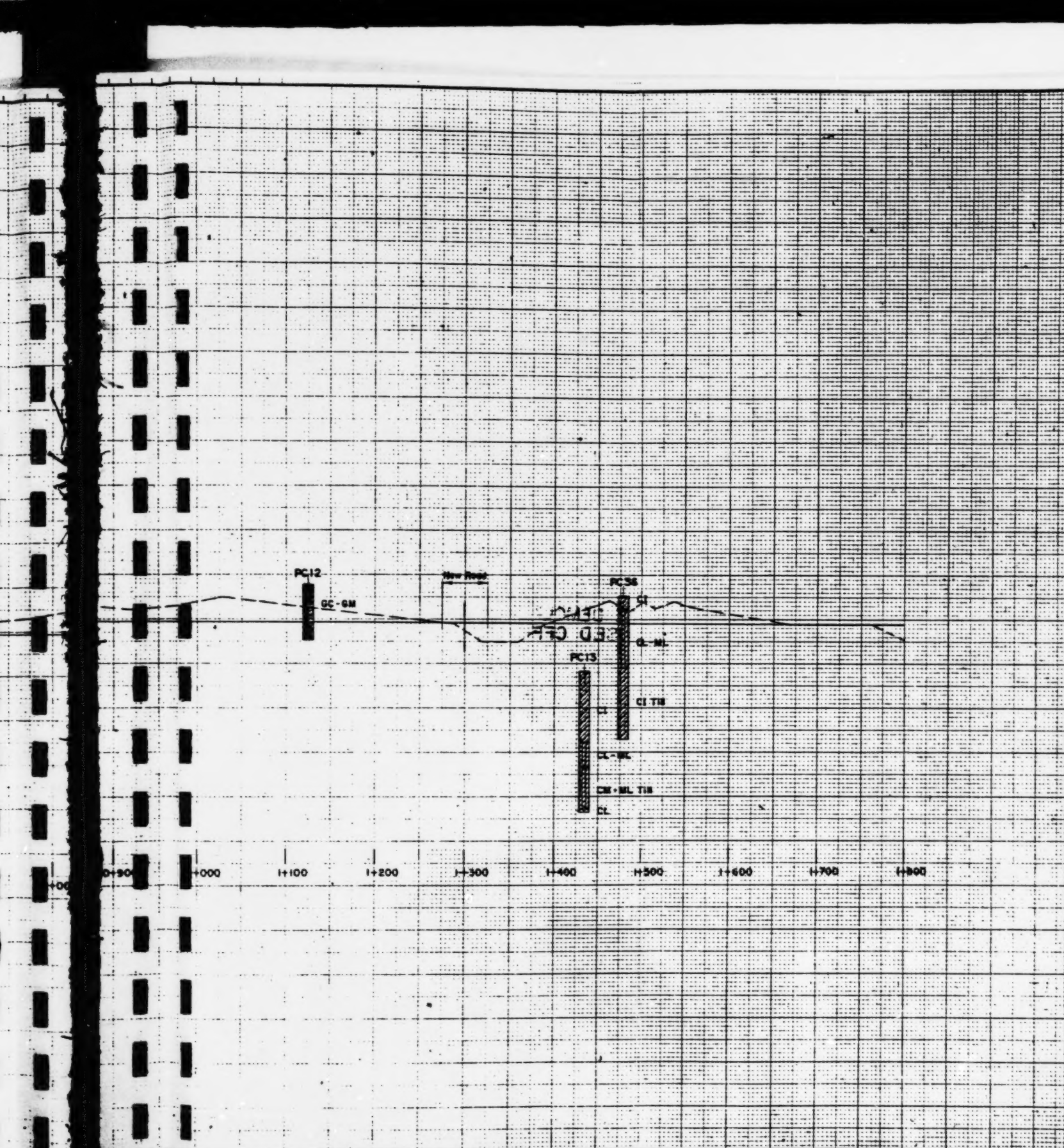
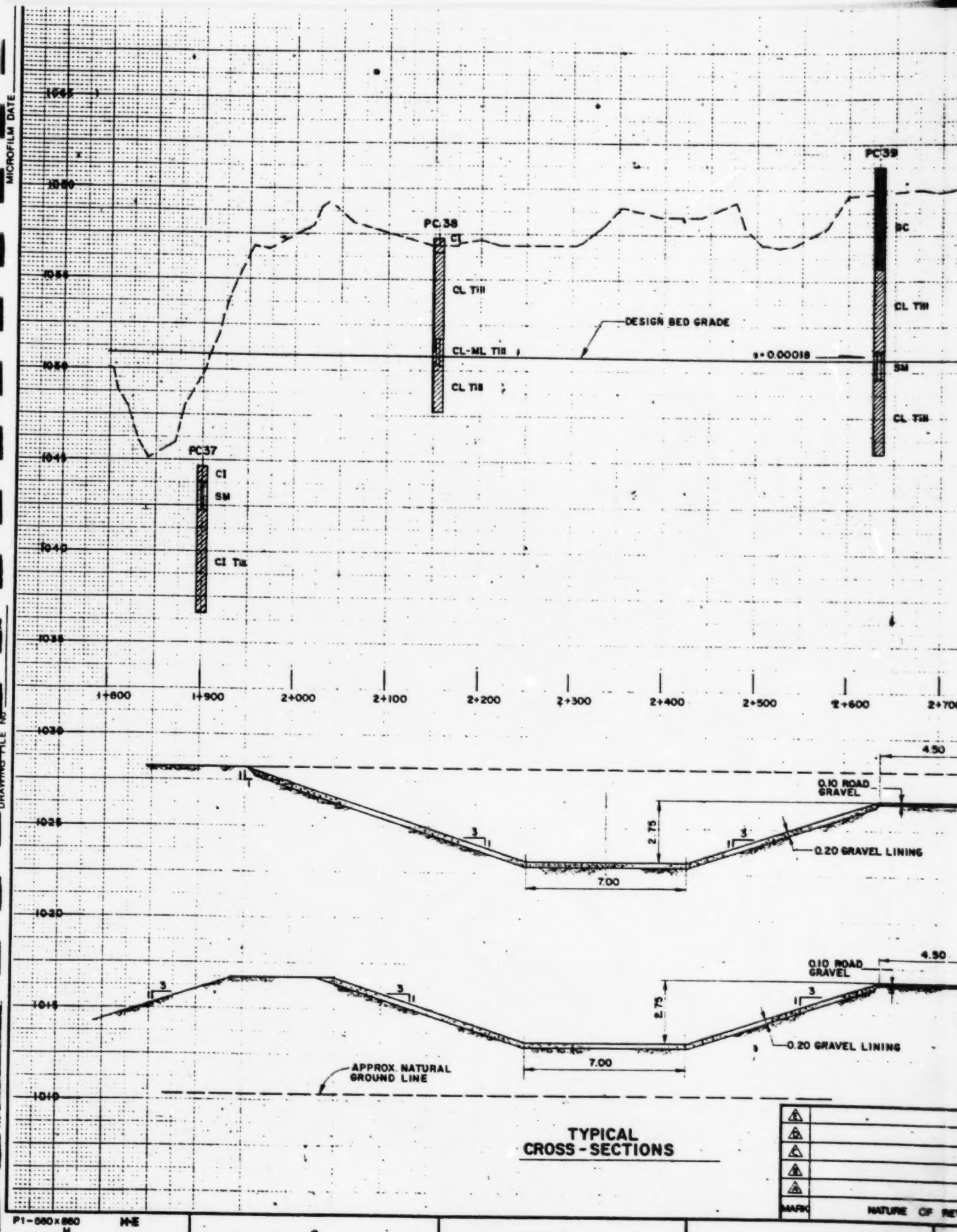


				Alberta ENVIRONMENT DESIGN AND CONSTRUCTION DIVISION	WILLOW CREEK PROJECT
					PINE COULEE RESERVOIR
					DIVERSION CHANNEL
				SUBMITTED ..... DESIGNED	PROFILE, Sta. 0+000 to Sta. 1+800
				DATE ..... CHECKED	
				APPROVED ..... DRAWN	SCALE Horiz. 1:2500; Vert. 1:125 / SHEET 7 OF 15
				DATE ..... CHECKED	DATE SEPTEMBER, 1985 / DWG. No.
	DATE	ENG.	DWN.		

D C B A



TYPICAL CROSS-SECTIONS

MICROFILM DATE

DRAWING FILE NO.

ENTRA... No.

P1-660x860

H H-E G F E

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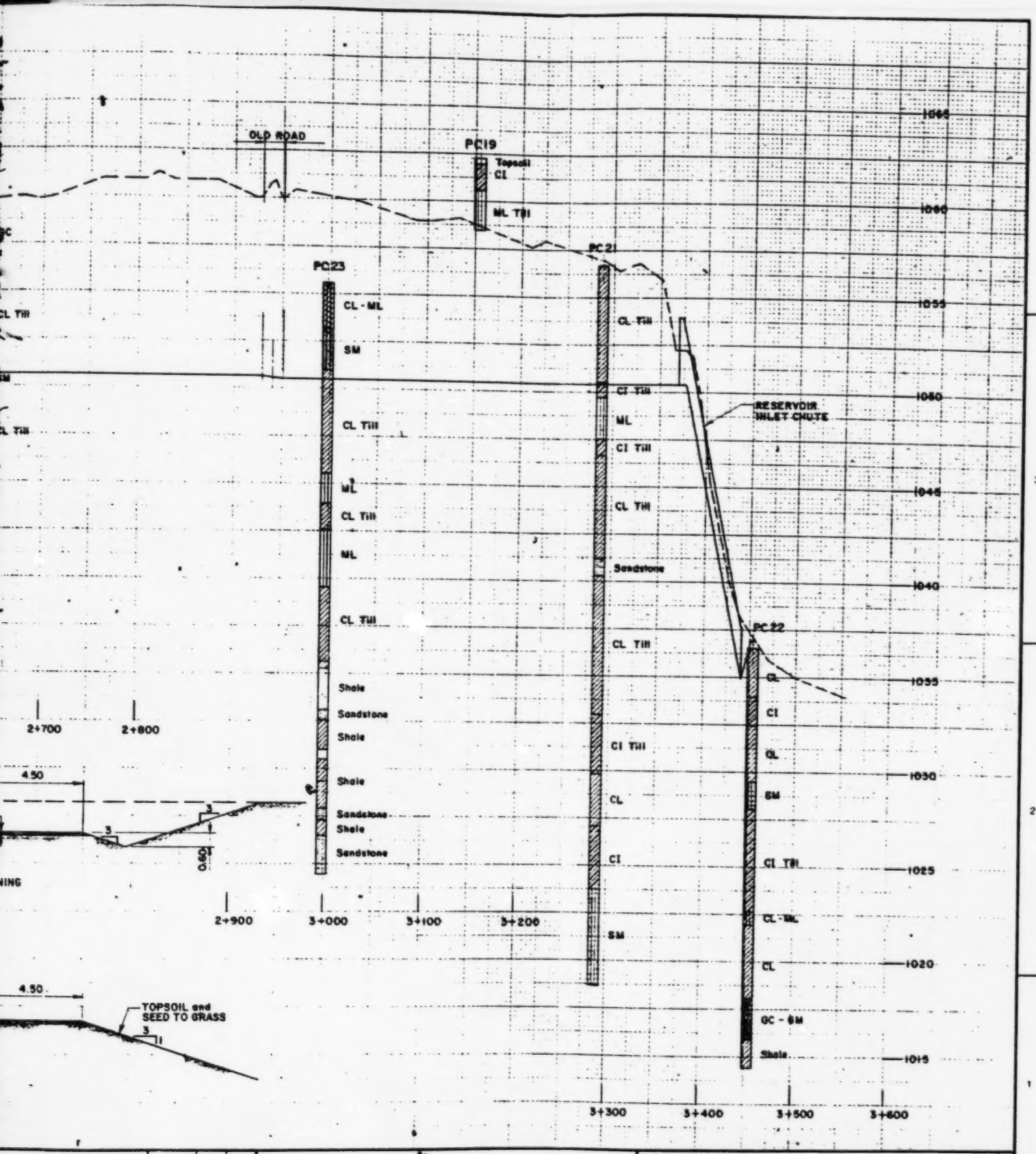


E OF REVISION	DATE	ENG.	DWN.		

Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

SUBMITTED	DESIGNED .....
DATE	CHECKED .....
APPROVED	DRAWN .....
DATE	CHECKED .....

WILLOW CREEK PROJECT

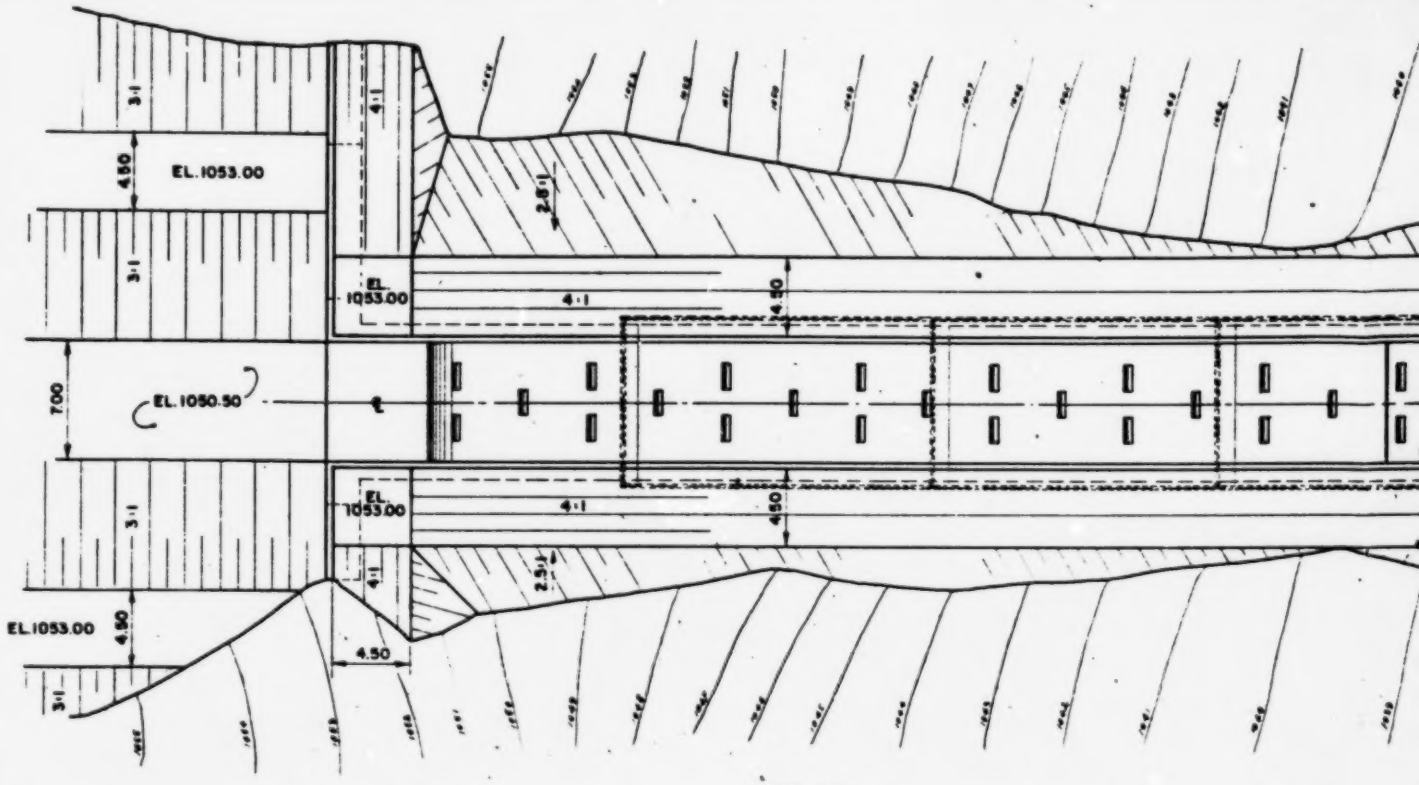
PINE COULEE RESERVOIR

DIVERSION CHANNEL

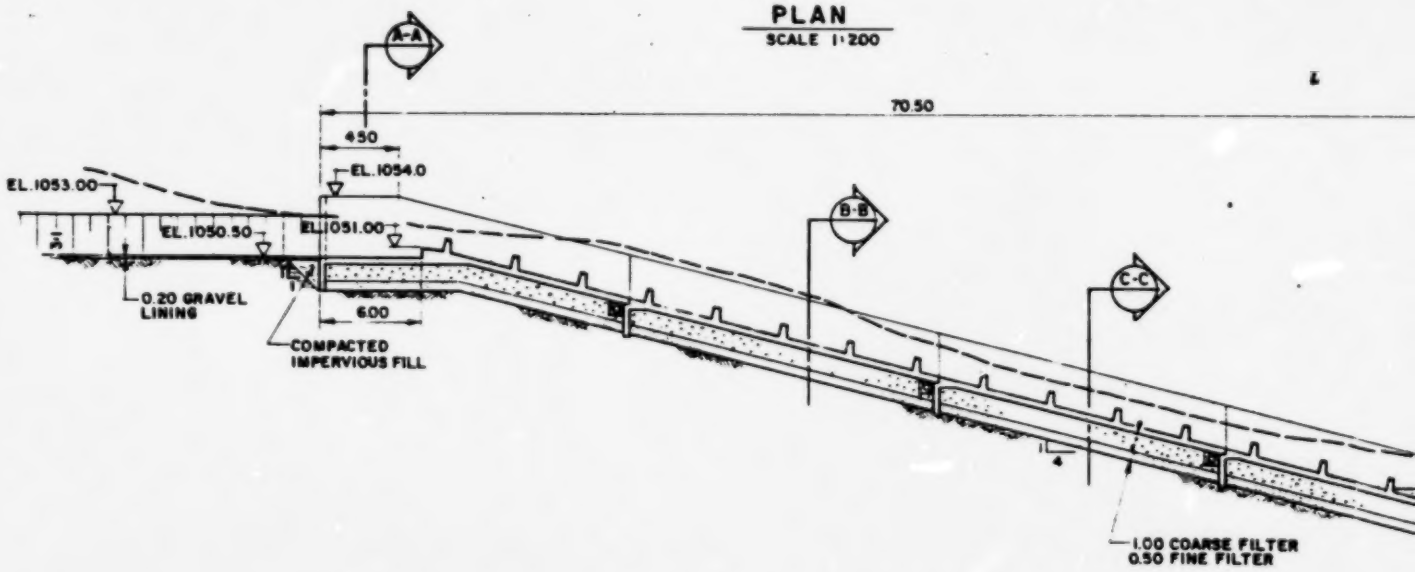
PROFILE, Sta. 1+800 to Sta. 3+550

SCALE Horiz. 1:2500; Vert. 1:125	SHEET 8 OF 15
DATE SEPTEMBER, 1985	DWG. No.

D C B A



PLAN
SCALE 1:200



CENTERLINE PROFILE
SCALE 1:200

MARK	NATURE OF REVISION
1	
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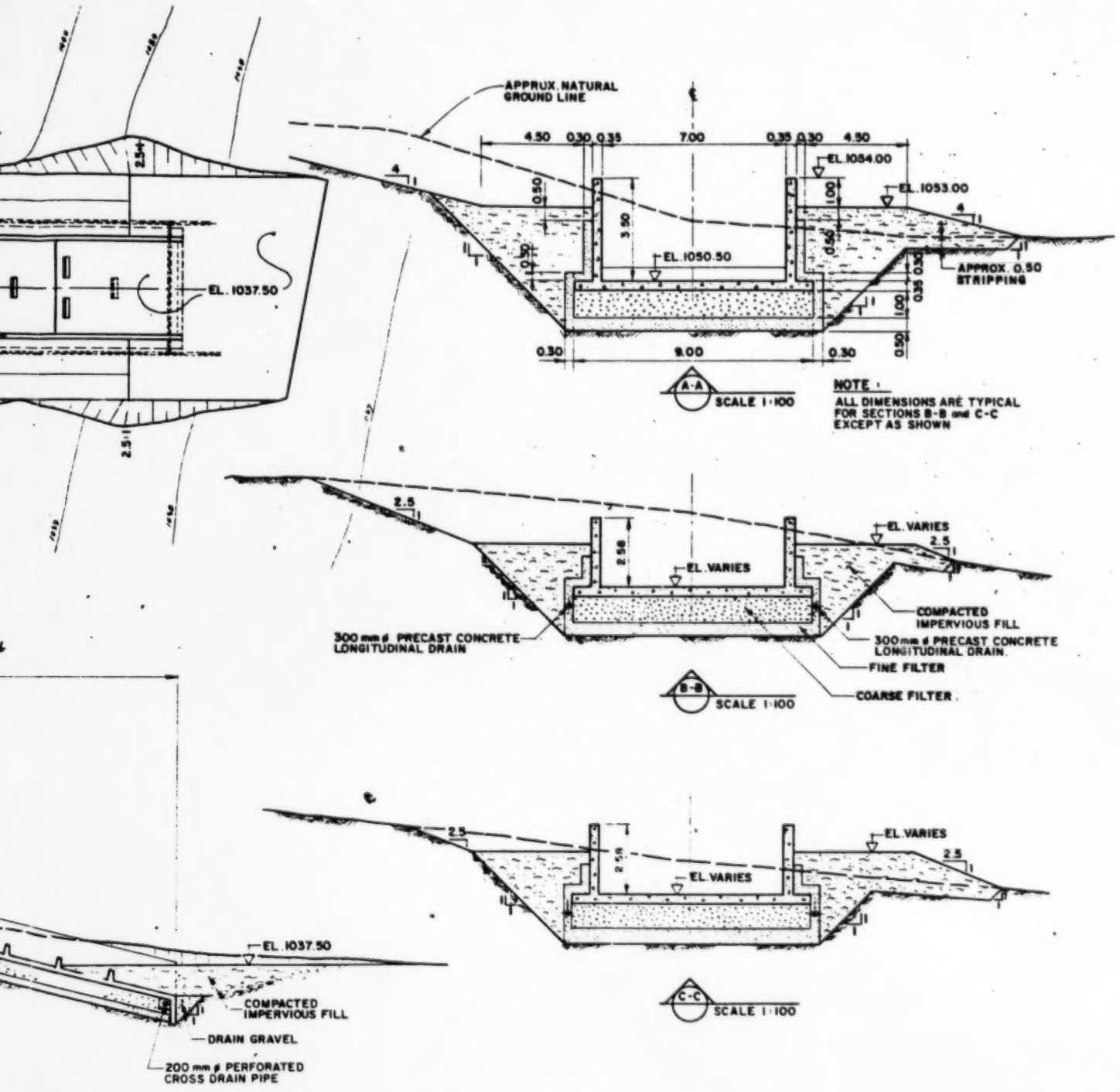
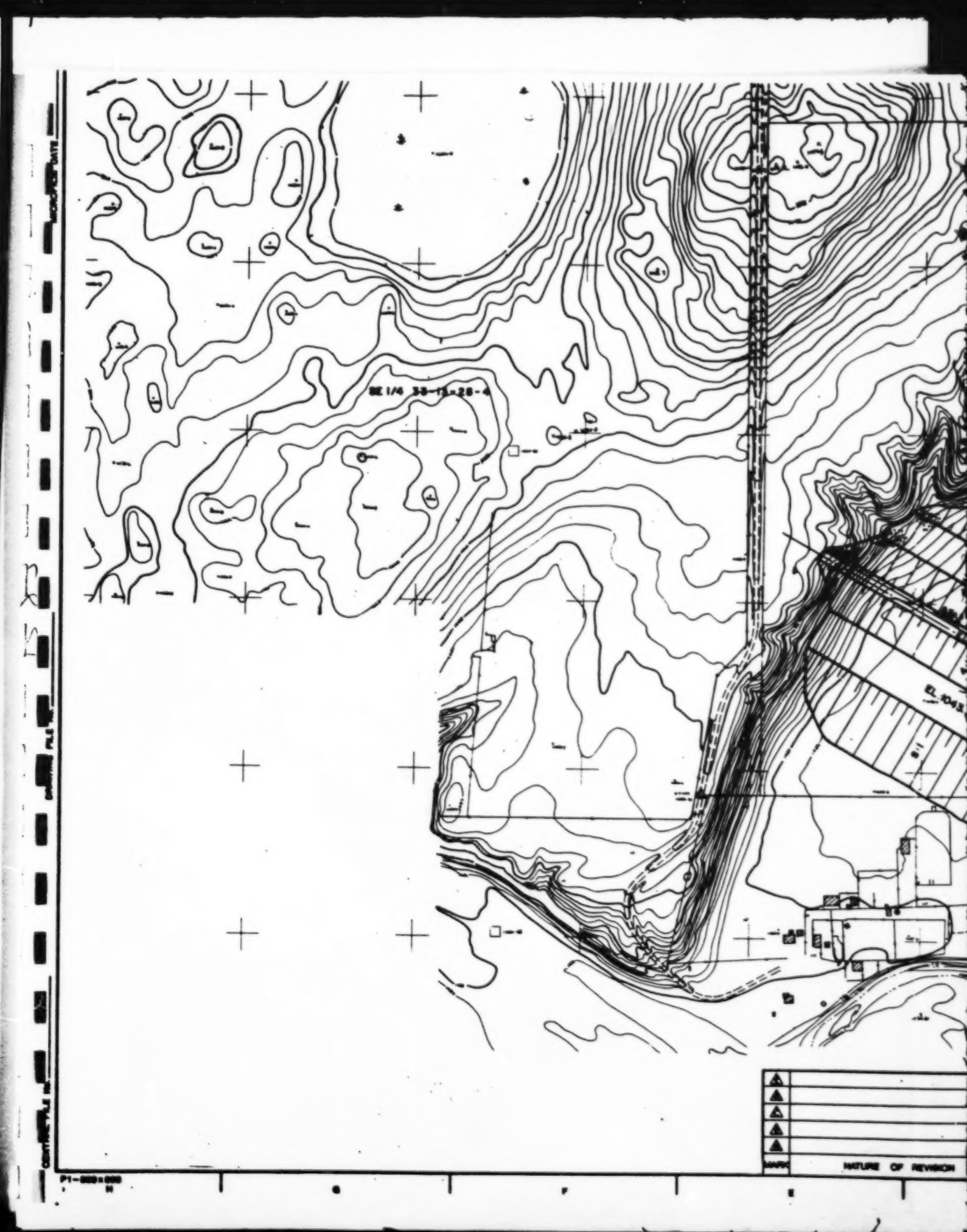
MICROFILM DATE
DRAWING FILE No.
CENTRAL FILE No.

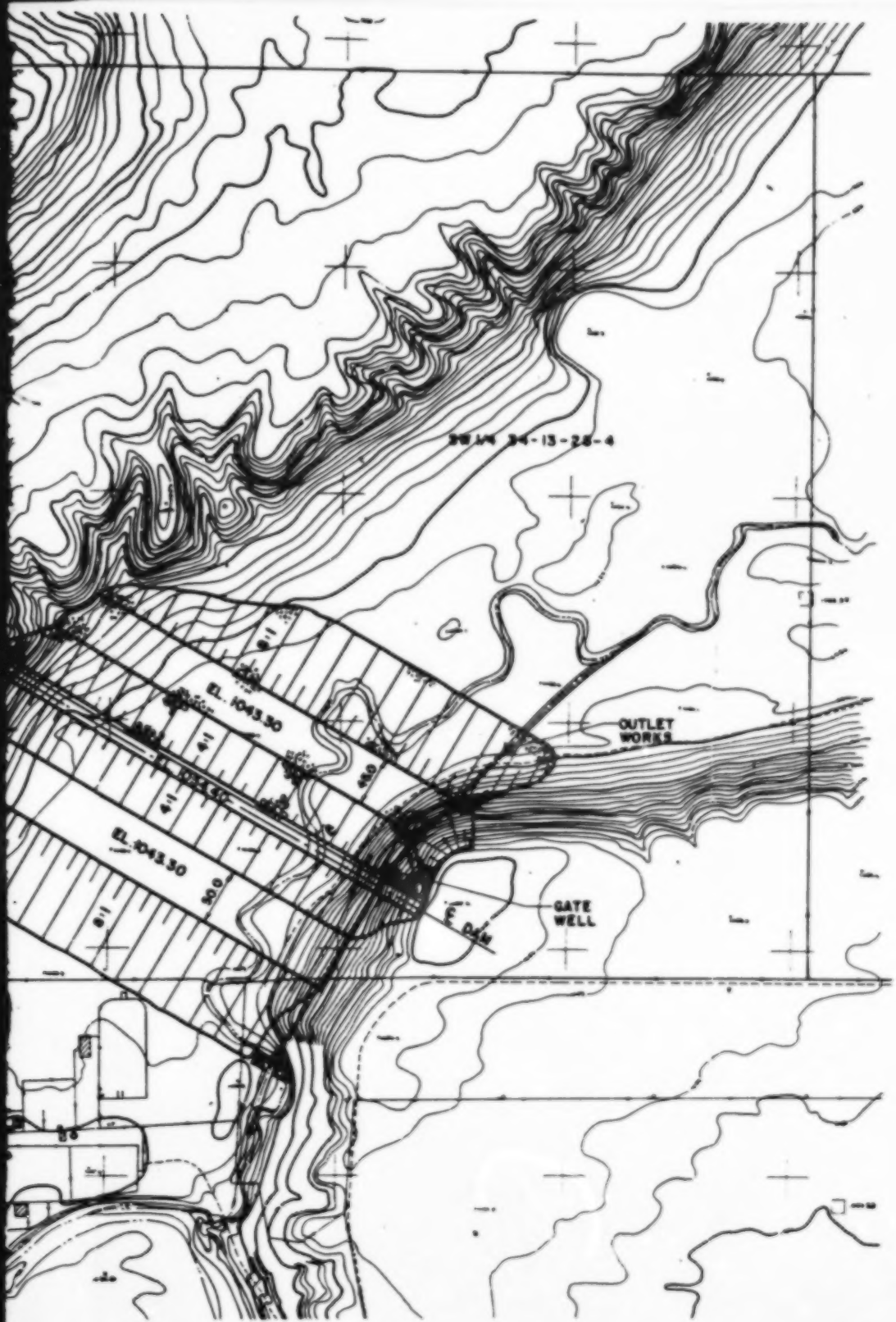
P1-880x880 H-E
H G F E



				Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION	WILLOW CREEK PROJECT	
					PINE COULEE RESERVOIR	
				SUBMITTED ..... DESIGNED	RESERVOIR INLET	
				DATE ..... CHECKED	PLAN and PROFILE	
				APPROVED ..... DRAWN	SCALE AS SHOWN	SHEET 9 OF 15
OF REVISION	DATE	ENG.	DWN.	DATE ..... CHECKED	DATE SEPTEMBER	DWG No

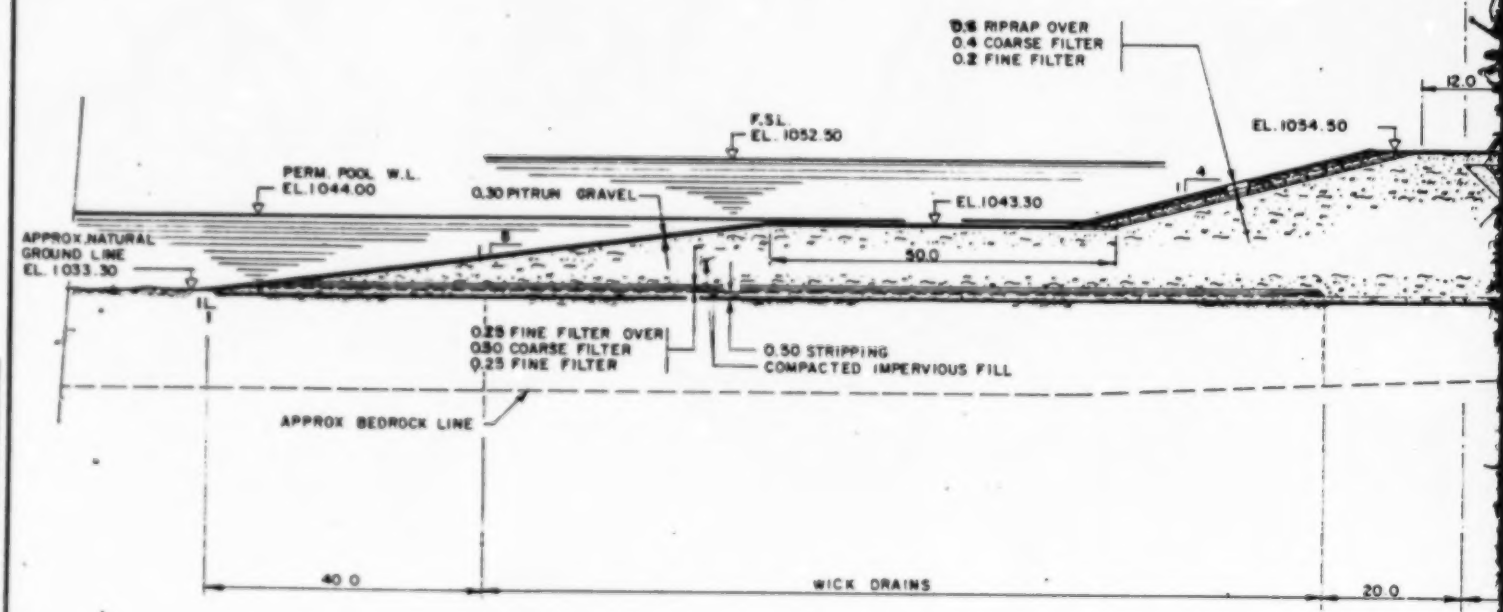
D C B A


SE 1/4 33-13-28-4
MARK
NATURE OF REVISION



				Alberta Environment	WILLOW CREEK PROJECT	
					PINE COULEE RESERVOIR	
				SUBMITTED ..... DATE	DESIGNED ..... CHECKED	DAM EMBANKMENT GENERAL PLAN
				APPROVED ..... DATE	DRAWN ..... CHECKED	SCALE 1:2500 / SHEET 10 OF 15 / DATE SEPT., 1989 / DWG. No.
NATURE OF REVISION	DATE	ENG.	DWN.			

D C B A



TYPICAL CROSS SE

MARK	NATURE OF REVISION
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MICROFILM DATE

DRAWING FILE No. COR

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P1-580x860 H

N-E

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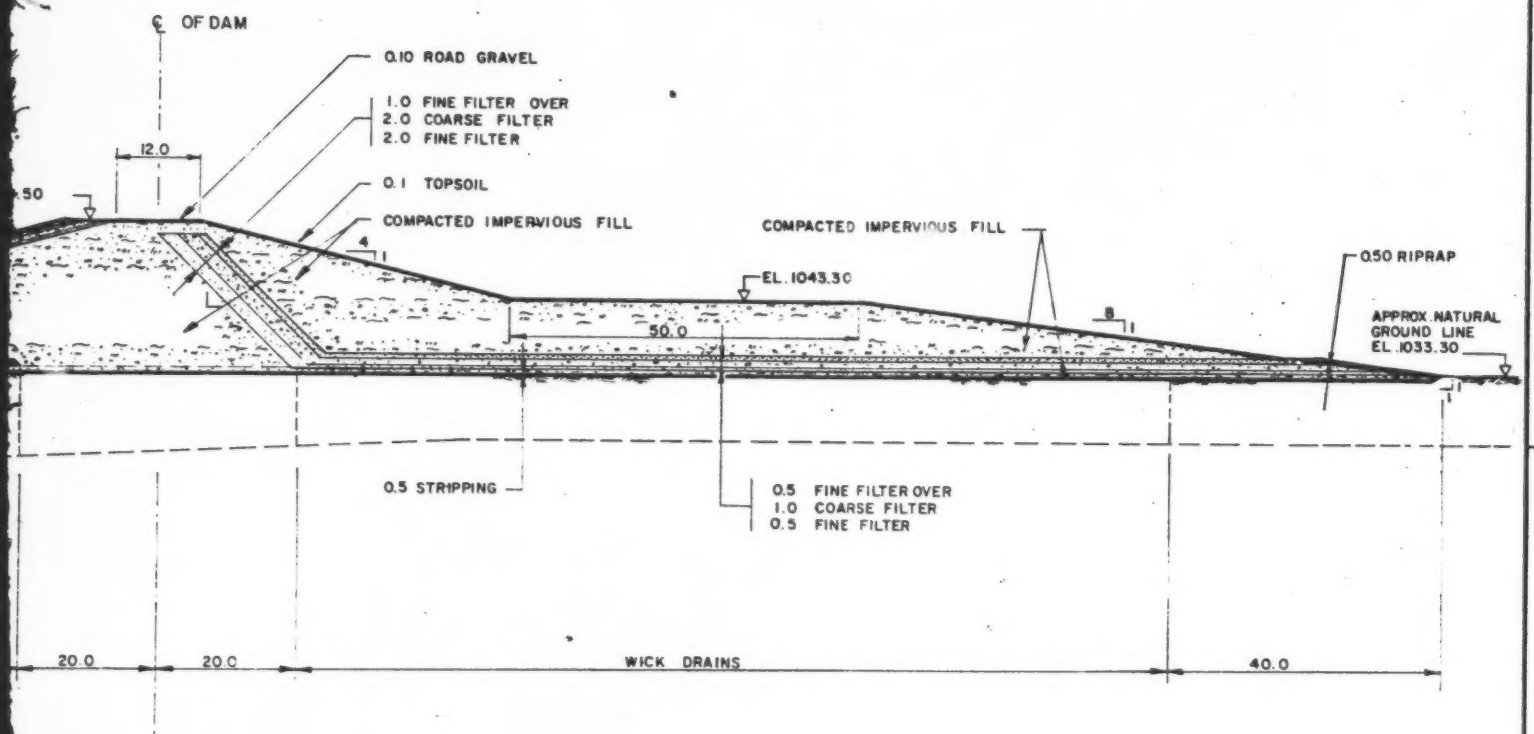


CROSS SECTION

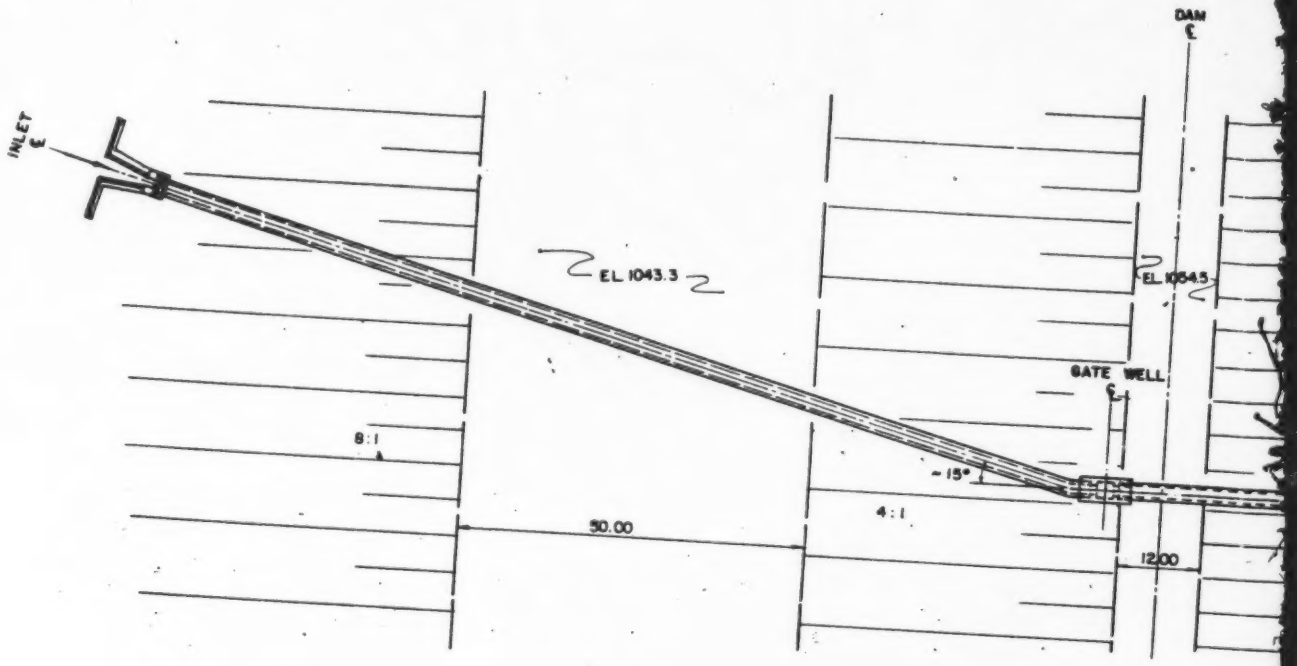
				Alberta ENVIRONMENT DESIGN AND CONSTRUCTION DIVISION		WILLOW CREEK PROJECT
						PINÈ COULEE RESERVOIR
				SUBMITTED	DESIGNED	TYPICAL DAM EMBANKMENT CROSS SECTION
				DATE	CHECKED	
				APPROVED	DRAWN T. Spitzbart	SCALE 1:500 / SHEET 11 OF 15
TURE OF REVISION	DATE	ENG.	DWN.	DATE	CHECKED J. Sal.	DATE AUGUST, 1985 / DWG. No PICOR - E85 - 11

D C B A

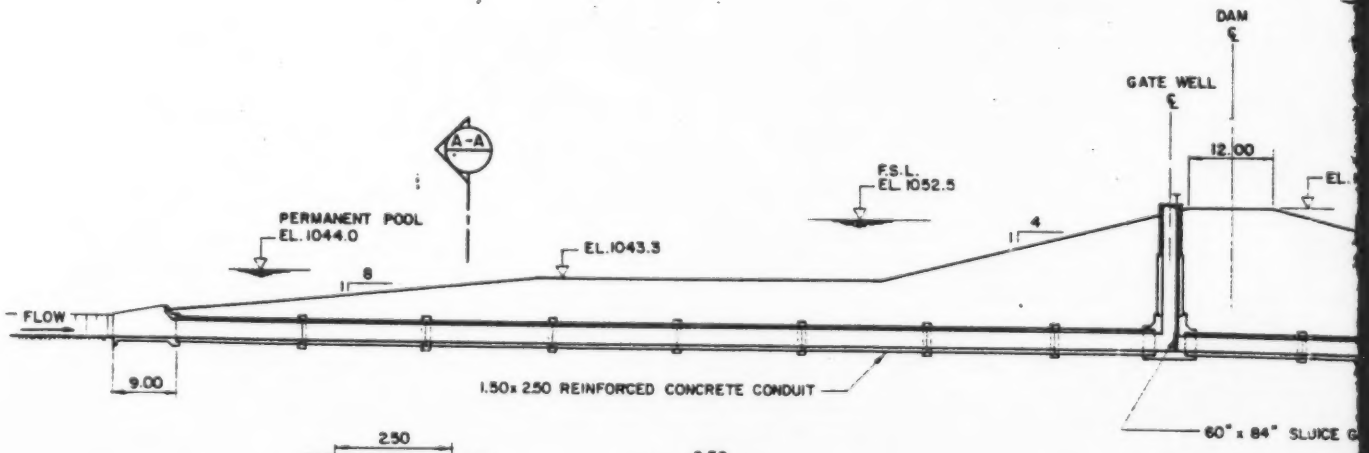
MICROFILM DATE

DRAWING FILE No. 7100W 128

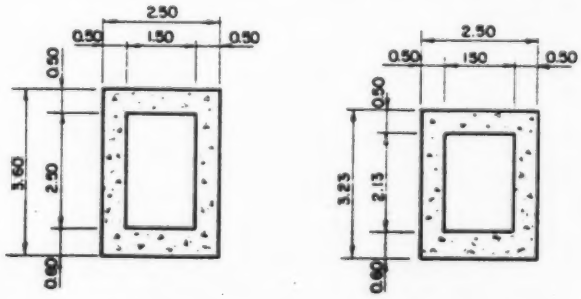
CENTRAL FILE No.



PLAN
SCALE 1:500



CENTRE LINE SECTION
SCALE 1:500



A-A SCALE 1:75

B-B SCALE 1:75

MARK	NATURE OF REVISION
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P1-660x880 H

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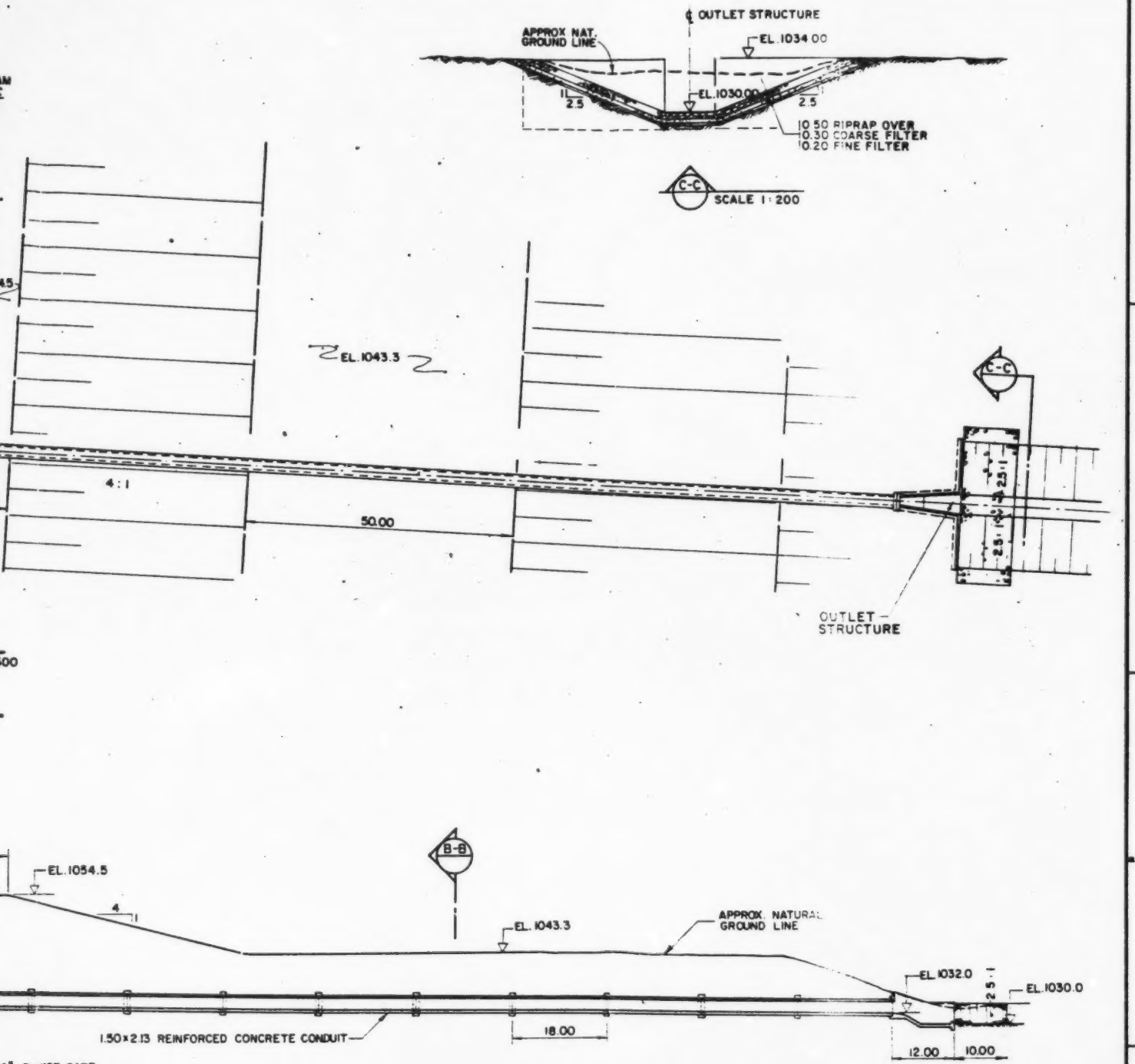


4" SLUICE GATE

TION

OF REVISION	DATE	ENG.	DWN.

Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

SUBMITTED	DESIGNED .....
DATE	CHECKED .....
APPROVED	DRAWN .....
DATE	CHECKED .....

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR

OUTLET WORKS

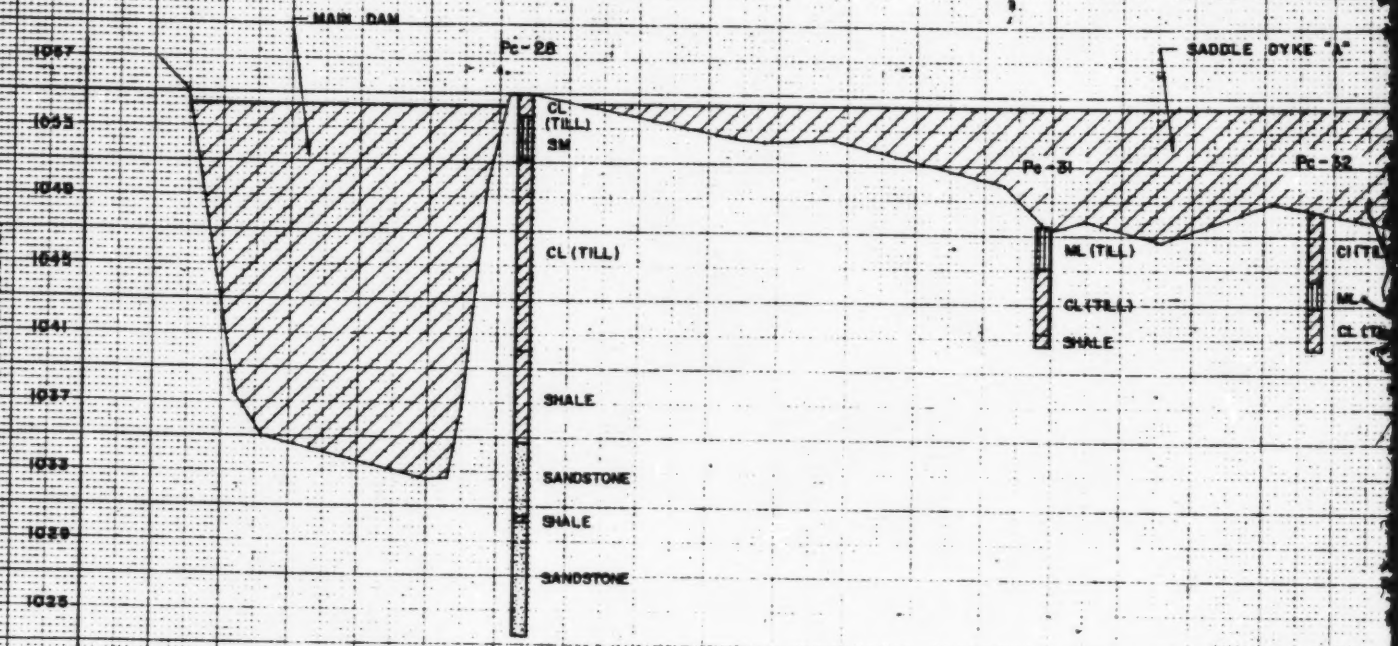
SCALE AS SHOWN	SHEET 12 OF 15
DATE AUGUST, 1985	DWG. No. PICOR - E85-12

D C B A

MICROFILM DATE

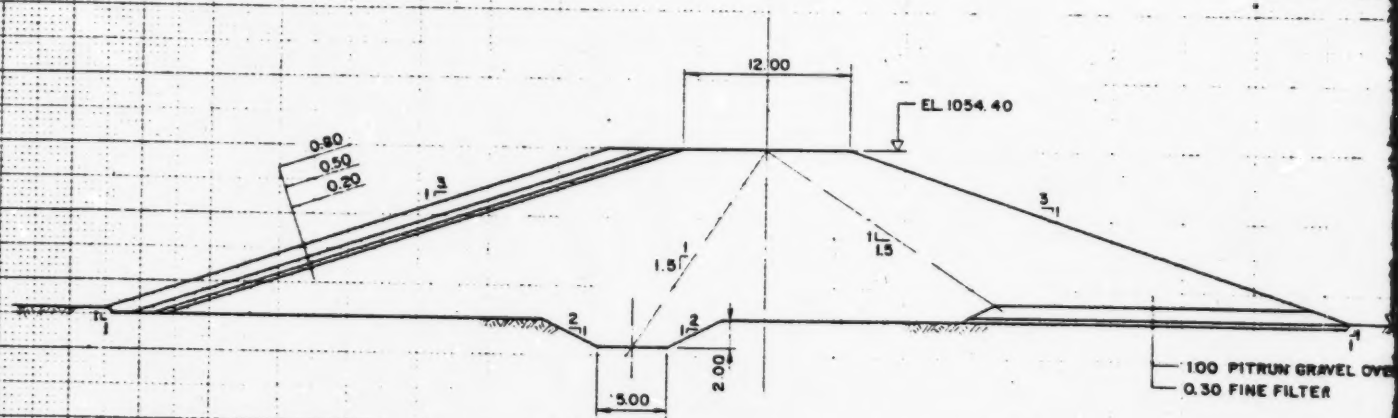
DRAWING FILE No.

CENTRAL FILE No.



PROFILE

SCALE HOR.



12 m. HIGH SECTION

SCALE 1 : 250

MARK	NATURE OF REVISIO
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P1-660x860

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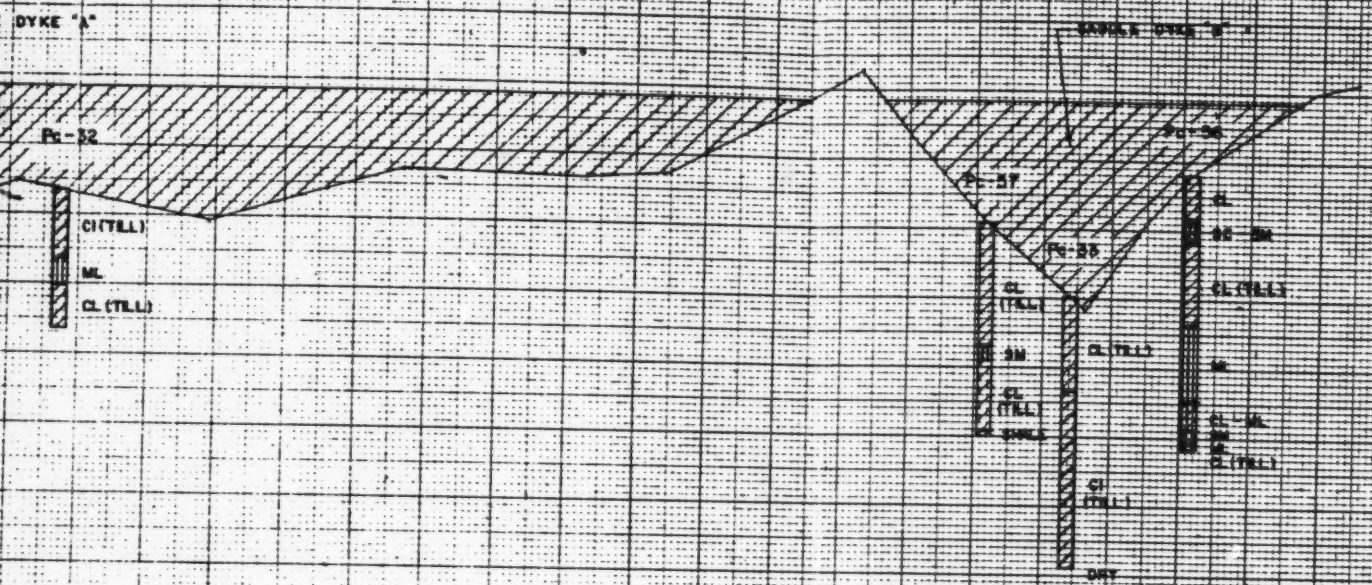
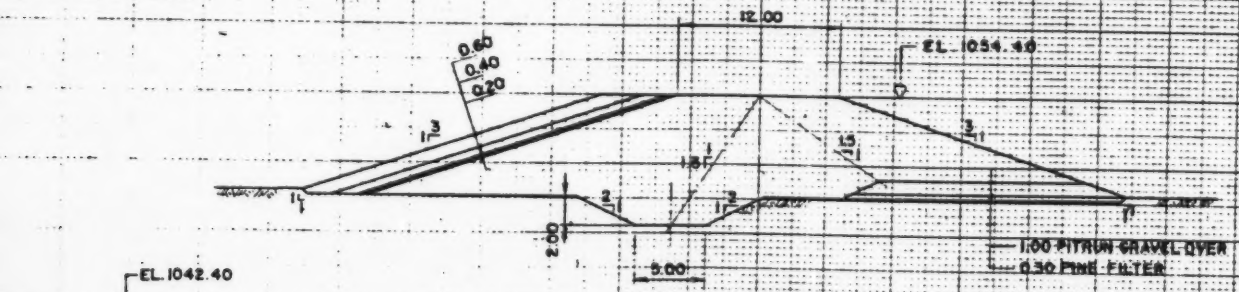
DYKE "A"



PROFILE

SCALE HOR. 1:5000



7m HIGH SECTION

SCALE 1:250

E OF REVISION	DATE	ENG.	DWN.		

Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

WILLOW CREEK PROJECT

PINE COULEE RESERVOIR

SADDLE DYKE

SUBMITTED	DESIGNED .....
DATE	CHECKED .....
APPROVED	DRAWN .....
DATE	CHECKED .....

SCALE HOR. 1:5000 — SHEET 13 OF 18

DATE SEPT., 1985 — DWG. No.

D C B A

MICROFILM DATE
DRAWING FILE No.
CENTRAL FILE No.

S.E. 15-14-28-4

BORROW AREA

HWY. #527

N.E. 10-14-28-4

PL
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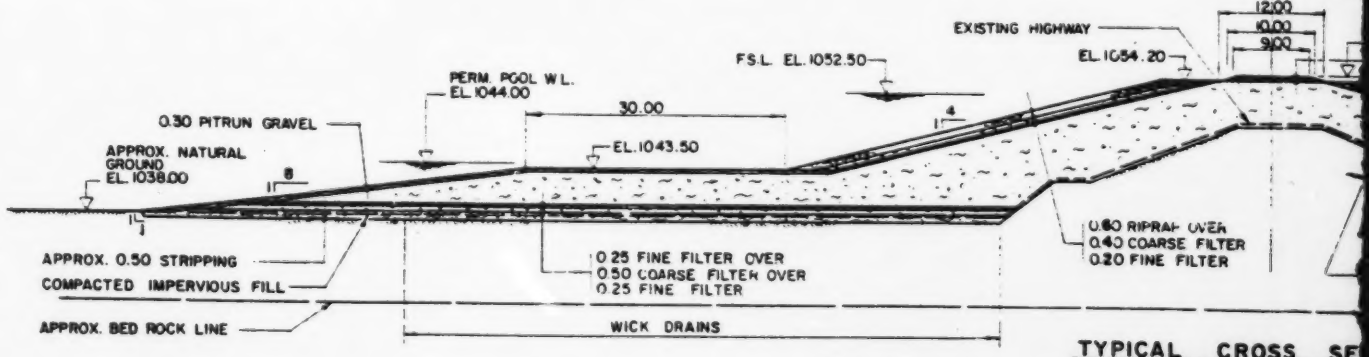

TYPICAL CROSS SE
SCALE 1:400

MARK	NATURE OF REVISION
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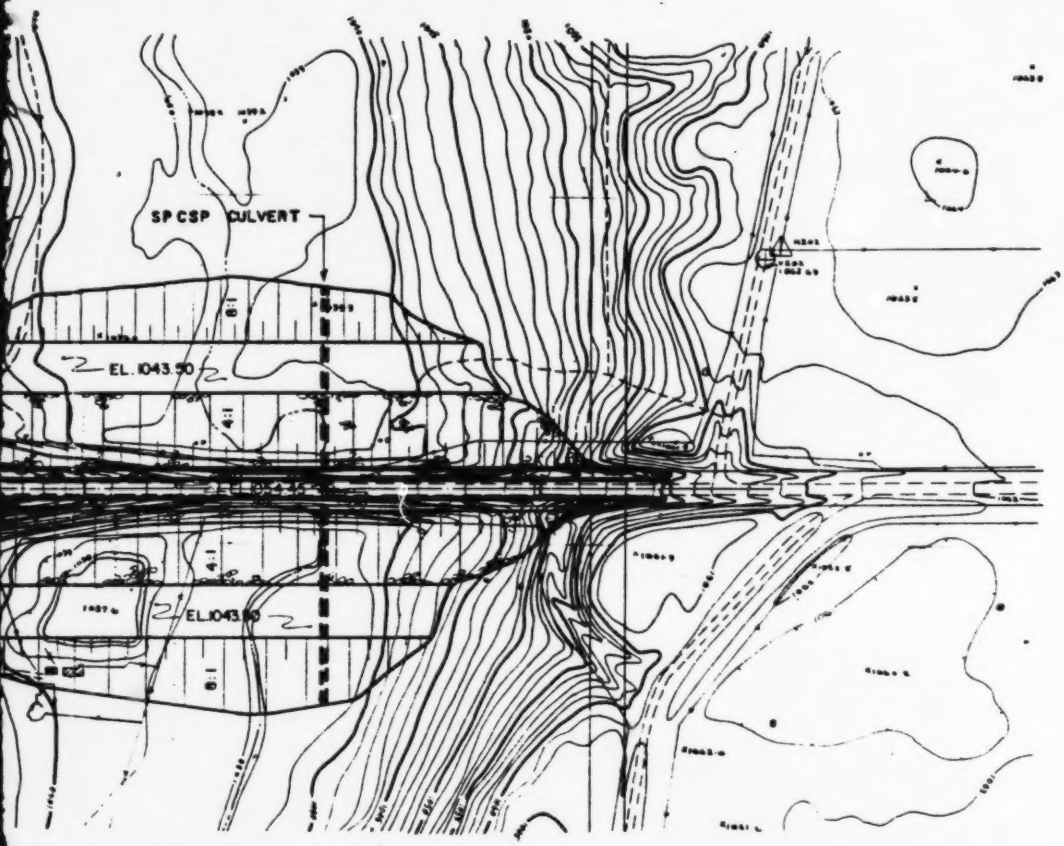
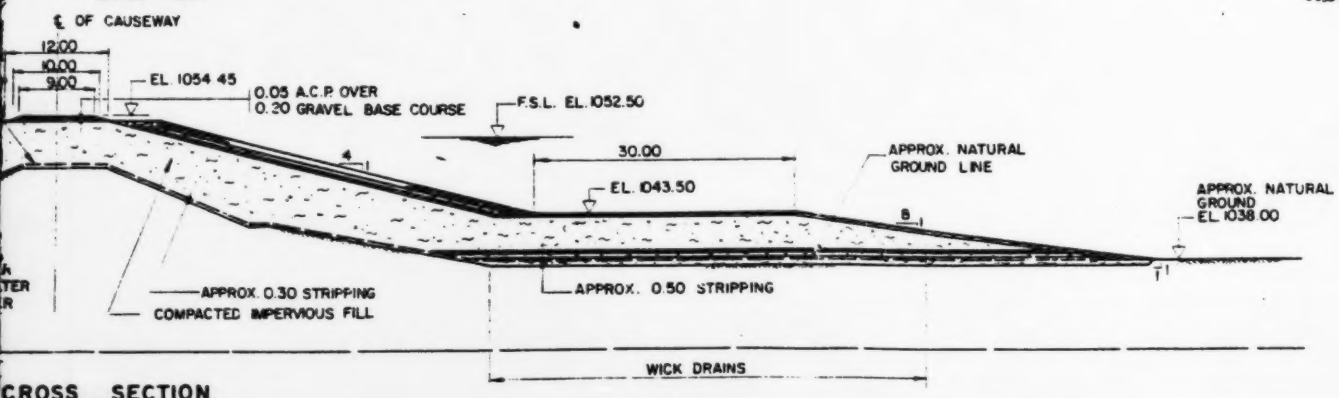
P1-880x680



PLAN
SCALE 1:2000



CROSS SECTION
SCALE 1:400

NO.	OF REVISION	DATE	ENG.	DWN.

Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

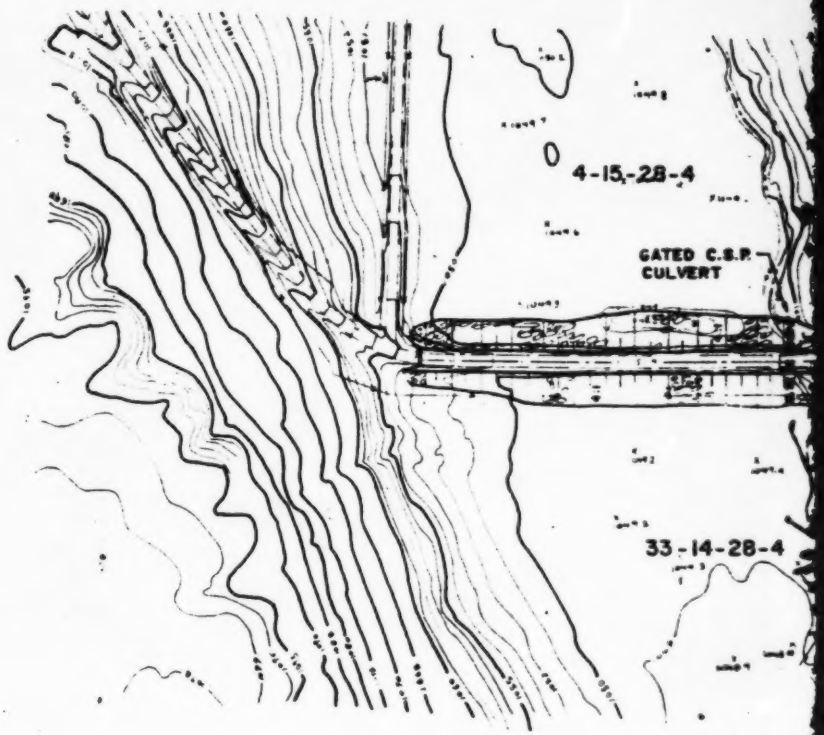
SUBMITTED	DESIGNED
DATE	CHECKED
APPROVED	DRAWN
DATE	CHECKED

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR

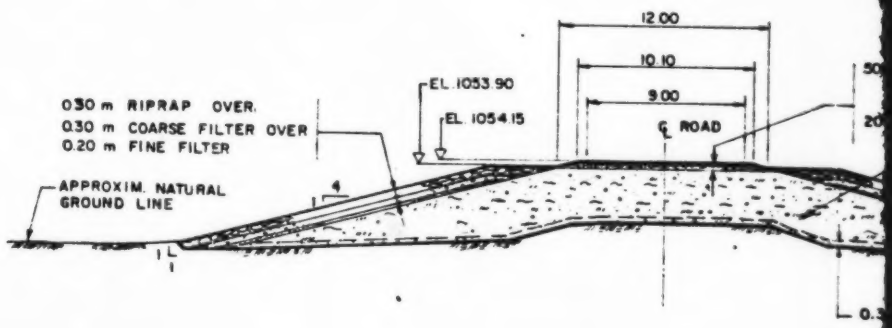
CAUSEWAY @ HIGHWAY # 527

SCALE AS SHOWN	SHEET 14 OF 15
DATE AUGUST, 1985	DWG. No PICOR - E85-18

D C B A



PLAN
1:2 000



TYPICAL CROSS SECTION
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MARK	NATURE OF REVISION
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MICROFILM DATE

DRAWING FILE No TYCOR 7-36

CENTRAL FILE No

P1-560x860
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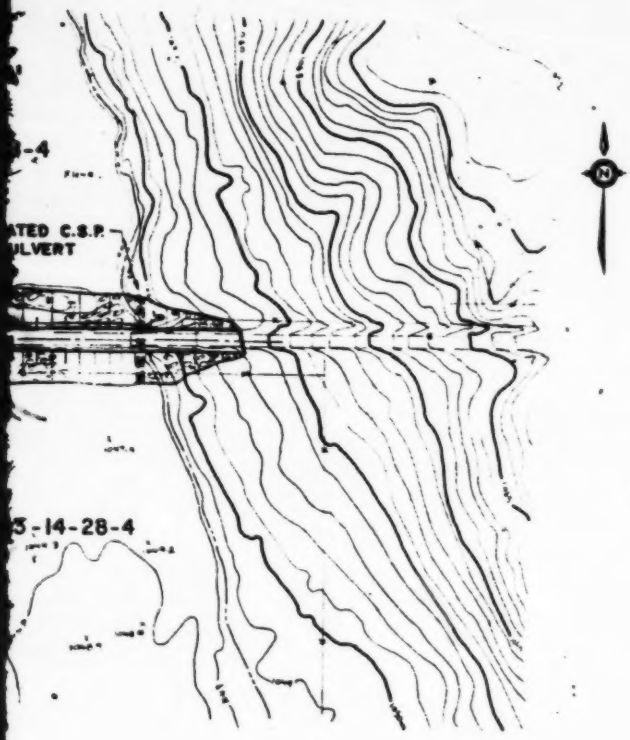

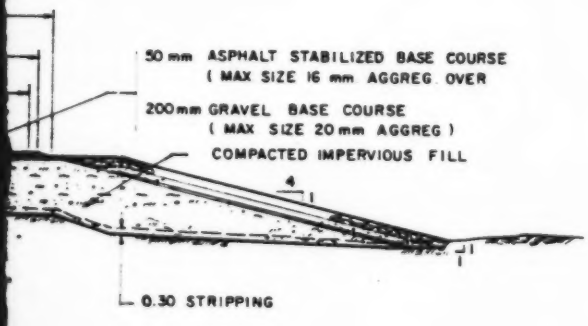

S SECTION

				Alberta ENVIRONMENT DESIGN AND CONSTRUCTION DIVISION	WILLOW CREEK PROJECT
					PINE COULEE RESERVOIR
				SUBMITTED ..... DESIGNED	CAUSEWAY E.-W. ROAD
				DATE ..... CHECKED	N. BDY. OF 33-14-28-W4
NATURE OF REVISION	DATE	ENG.	DWN.	APPROVED ..... DRAWN T. Hyatchuk	SCALE AS SHOWN / SHEET 18 OF 15
				DATE ..... CHECKED B.A.	DATE AUGUST, 1985 / DWG. No. PICOR-E85-19

D C B A